DOCUMENT RESUME

ED 066 899 EM 010 225

AUTHOR	Wolf, W. C., Jr.
TITLE	A Critical Review of Strategies Intended to Modify Behavior.
INSTITUTION	Massachusetts Univ., Amherst.
SPONS AGENCY	Office of Education (DHEW), Washington, D.C.
PUB DATE	19 May 71
CONTRACT	OEC-0-71-1234
NOTE	145p.
EDRS PRICE	MF-$0.65 HC-$6.58
DESCRIPTORS	*Adoption (Ideas); *Behavior Change; *Change Agents; Changing Attitudes; Diffusion; Information Dissemination; Information Sources; Innovation; *Publicize; Training
IDENTIFIERS	*Specific and Incidental Training

ABSTRACT

Decisions about techniques for modifying human behavior are usually made either wholly within the sphere of specific training techniques or within the sphere of non-training techniques (i.e., Madison Avenue, change agent, or market research strategies), rather than considering both modes as possibilities. In this paper, specific techniques from both modes are presented, along with a frame of reference incorporating many of the conditions necessary for changes in human behavior, so that planners can select optimal strategies to induce change. (RH)

ED 066899

OEC-0-71-1234

A CRITICAL REVIEW OF STRATEGIES INTENDED TO MODIFY HUMAN BEHAVIOR

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by

W.C. WOLF JR.
PROFESSOR OF EDUCATION
UNIVERSITY OF MASSACHUSETTS
AMHERST, MASS.

Submitted to

THE U.S. OFFICE OF EDUCATION
WASHINGTON, D.C.
MAY 19, 1971

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EM 010 225

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PREFACE

Two means of modifying human behavior are treated within this paper: one involving specific training; and the other unrelated to specific training. Examples drawn from military training operations lend support to the usefulness of the former means, while examples drawn from the enterprise of rural sociologists lend support to the usefulness of the latter means. It is not unreasonable to believe each is an effective technique when used properly.

Both have been considered in this paper, because both are viable means to modify human behavior. Unfortunately, few individuals who wish to do this view them as viable options. Decisions are usually made to pursue one or the other, rather than weigh the relative merits of each in terms of tasks to be accomplished. As a result, an extension service evolved for farmers' continuing well-being and NSF or NDEA institutes evolved for educators' in-service education. What if these enterprises had been reversed? Or, a combination of the two had been utilized over the years? Imagine the possibilities.

Whatever, educators have been locked into only one of these in-service traditions--the specific training pattern--over the past several decades. This tradition is manifested in summer or academic year institutes, workshops, conferences, retreats, and so forth. And even though much literature exists to support the effectiveness of the tradition, in fact, as it has been and continues to be used,

more is left to the imagination than to realized performance outcomes. Evidence offered in this paper readily justifies such an observation.

Now, there isn't anything inherently evil in the tradition itself. It is the utilization of the tradition that is at fault. Factors like trainee selection, program planning, trainee practice, performance outcomes, and on-the-job operations, must be carefully considered by program directors if behavioral modification is to be attained. Neglect of these factors enhances the prospect of program failure. Evidence offered in this paper strongly infers that program directors routinely neglect many of these factors.

Certain conditions are called for in order to modify human behavior effectively. These conditions can be strongly inferred from an accumulating research history on training undertakings. More work is still needed before strong inference can be expanded by empirical documentation. A frame of reference, incorporating many of these conditions, is offered to support the hypothesis that this educational tradition is an effective technique for modifying human behavior.

In addition, a parallel strategy not tied to specific training is offered for contemplation by individuals responsible for in-service training activities. This tradition is based upon the work of rural sociologists and social psychologists. Their work is viewed in the context of the fields of agriculture and medicine. Finally, extensions of their work within the field of education are reported as illustrations of promising activity underway. Work in progress at the Far West Educational Research and Development Laboratory represents this thrust.

Sources of information utilized in accumulating raw materials for this report include the USOE's ERIC repository; the Defense

Department's DDC repository; numerous technical journals, dissertations, and books; and, several studies completed by the author and his students. This report is intended as an overview, rather than a comprehensive treatment, of the literature on behavioral modification. Its foci are specific training techniques and techniques not related to specific training (i.e., Madison Avenue strategies, change agent strategies, market research strategies). Included in the report are accounts and abstracts of an extensive array of completed studies on each of these topics. Critical commentary is offered by the author throughout the document.

W.C. Wolf Jr.

ORIENTATION

During the course of surveying the literature on training strategies intended to modify behavior, this researcher continually uncovered studies which didn't fit but which seemed pertinent to the search. These studies focused upon strategies which were unrelated to specific training but which described considerable behavior modification nevertheless. The accumulating import of these studies eventually convinced the researcher to include exemplars from this set as a part of the paper.

Hence, this report describes two kinds of change strategies: those involving specific training; and, those unrelated to specific training. The former area is stressed.

An orientation to each of these areas is offered in this section. Then, studies pertaining to the two kinds of change are described. A frame of reference for change is offered next. Conclusions are drawn from the information accumulated.

Specific Training

If the development of the form and content of training were reduced to a mathematical model of all the variables essential to the design of the teaching enterprise, and if the values of all parameters were known, obviously the information essential to the design of training could be precisely specified in kind and structure. In the absence of such a design model (and its absence implies the need for decision-

making and inventive processes), the gathering, classifying and organizing of input information to training design must, of necessity, be heuristic rather than precise.

Training, like the psychology of child-raising, has many fads and local prejudices depending on subject matter. When a person is taught to drive, the instructor usually comes straight to the point and gives him practice in various tasks of driving. The person is not given the physics of traction, or of internal combustion engines. But when he is taught to become a ham radio operator, he virtually learns how to design and build the equipment which the task requires only that he operate. Training in many areas of human endeavor includes much of what seem, from objective standards, initiatory and tribal rituals. Thus an actual description of performance requirements may often seem meager and trivial when compared with the ritualistic forms of training which are provided the trainee. Science offers some guides to the art of training by helping to differentiate the irrelevant and ritualistic from the essential.

Training is defined as the planned sequences of experience leading to proficiency in specified patterns of stimulus-response type relationship. Training design may therefore be measured by three major criteria:

a) validity, or the extent to which training experiences are relevant as measured by transfer to the job situation;

b) completeness, or the extent to which additional on-the-job experiences are not required for reaching job proficiency criteria;

c) efficiency, or the relative cost in time, dollars and talent of the training.

A good job or task description is one which specifies what criterion responses should be made to what task stimuli and under what ranges of conditions. To the extent that the terms and the organization of the description refer to principles of learning and transfer of training in the scientific literature, the task description aids the design of efficient training.

This definition is offered as a rule of thumb to be applied to the literature described in subsequent sections of the paper. It was selected as a logical point of departure for viewing such training. Unfortunately, the definition proved too demanding, as few of the studies cited meet its conditions. It is useful, nevertheless, because it helps to account for the failings of a fair amount of the work described.

Much has been learned about training in recent years which could be incorporated by program planners. Unfortunately, few planners seem inclined to seek out the accumulating information. Charles C. Jung of the Northwest Regional Educational Laboratory recently prepared a list of generalizations about training. He retrieved them from research, evaluation and experience in developing training designs and materials. They are derived primarily from work of the Institute for Social Research of the University of Michigan, the National Training Laboratory's Institute for Applied Behavioral Science, and the Northwest Regional Education Laboratory. His list includes the following:

1. Expectations that an individual has about the nature and value of a training event often prove the best predictor of that individual's gains from the event.
2. The newer the orientations or skills are to the trainee, the more misleading will be attempts to describe them before the training event. This is a problem as accurate trainee expecta-

tions are critical. For very new areas, accurate expectations can best be aroused by focusing on purposes of the orientations or skills and analogies to them. Attempts at literal description can increase distortion of expectations.

3. Neither the learning of new knowledge nor changes in attitude are necessarily related to changes in behavior. One study showed no significant relationship between what teachers honestly believed in and thought they were doing in their classrooms as compared to what either trained research observers or their children saw them doing.
4. A major false assumption implicit in many training events is that people learn simply by doing. It is, rather, being able to see oneself attempting to do that is the feedback which provides learning. Experience without feedback guarantees nothing.
5. Most individuals have little understanding of the interpersonal skills of giving and receiving behavioral feedback. This creates a situation of depending in training events which many individuals react to negatively. A frequent further confusion is to interpret feedback as psychological, rather than behaviorally descriptive, in intent.
6. Positive reward supports change.
7. Training in teamwork processes is generally easiest to accomplish when members of trainee groups don't previously know each other, but has best follow through effect when actual back home work groups are used as the trainee groups.
8. Training events are generally facilitated when the trainer is from outside the system, or subsystem, of which the trainees are members.
9. In training situations, helpees allow influence from the helper

to the extent that they see themselves able to influence the helper--e.g., the relationship needs to be reciprocal, not dependent one way or the other. Most individuals are more active in a training situation when they are provided knowledge and criteria of competence to apply to themselves and each other than when they are being directly supervised and evaluated by an expert.

10. People can be involved in change while committed not to change.
11. Collusive ignorance (i.e., everybody privately thinks the same thing, but believes the others think differently, and nobody checks it out publicly) may often be maintaining a situation.
12. Several general patterns of reaction that an individual might take to a training situation have been identified as follows:
    - the individual who easily drops his back home behaviors and picks up the new ones in the training setting. As soon as he's back home, he just as quickly reverts to his old behaviors.
    - the individual who rejects the offerings of the training session outright. He performs training exercises on demand, but is continuously critical. His criticalness is passive in nature in that he does not argue the issues so as to expose his orientation to possible change.
    - the individual who comes with an accurate expectation and desire to learn and does so in a quiet manner.
    - the individual who actively tests out and explores all ideas that are presented. This individual sometimes appears argumentative and troublesome, but often gains and applies the most.
    - the individual who tries always to compromise to satisfy everybody. They are continually under stress and their behavior is unpredictable.

13. Resistance to change is most often based in legitimate concerns for maintaining the system. Recognition of such legitimacy and openness to include resistors can facilitate a change effort.
14. It can be critical that the individual recognize reward for changing. If the individual is not able to identify the positive effects resulting from his changes, he may revert to earlier behaviors assuming his efforts had been irrelevant.
15. Individuals typically have multiple groups roles and loyalties. Learning or practice of new orientations or skills may be resisted if the individual perceives that it will raise conflict in his multiple loyalties. A simple example would be the individual who resists learning a new professional skill for fear his increased professional value may bring increased demands that will take him away from his family role.
16. Results of training in interpersonal processes are most apt to show up first in family relationships and are more apt to endure there than on the job.
17. The more similar the conditions of the training setting to the back home setting, the more likely will be the application of new skills and orientation back home. This is a major rationale for the use of simulation techniques in training.
18. Unless there is some chance for trying out and practicing behavior under back home conditions, literally or by simulation training, an individual who may show change at the training site will not be likely to transfer it to his back home setting.
19. A critical moment for support of application of newly learned behaviors in the back home setting is at their first trial. A system norm supporting this sort of risk taking, irrespective

of first round success, is a critical dynamic for innovativeness.

20. An individual's application of new orientations and skills is usually heavily influenced by how they related tothe ongoing norms and procedures of his system. Training of individuals in new procedures is generally not effective unless there are changes made in their system to support their use.
21. Change has multiple interacting effects in a system which may yield unanticipated and undesired results.
22. Training to bring about major changes in a system generally demands active involvement and continuous support from the top administrator and other major influencers of the system.
23. Large industrial organizations are increasingly coming to see training as a function of continuous evaluation and growth of the institution rather than an occasional re-tooling kind of necessity. Correspondingly, responsibility for training is being moved up from a low level in personnel departments to a top level executive role.

The term training implied to Jung emphasis on the individual acquiring action competencies in performing skills. To him, training involves (1) identification of the skills, (2) description of behavior entailed by the skills, (3) performance of the behavior, (4) feedback to the performer and further performance by him.

Unfortunately, a number of these generalizations are subject to challenge. Circumstances and situations arise that call for behavior to be modified expeditiously and without regard for the human feelings, commitment, or involvement implied in a number of the generalizations included

Long ago, for example, the Navy figured out how to select and train

individuals to direct gun crews to hit moving targets within a prescribed range of acceptability. Once individuals were selected for the training needed, they were exposed to a series of prescribed tasks, which taken together, accounted for the desired terminal behaviors. Success, more work, or wash-out were the performance options open to the candidates. Trainees who successfully completed the program gave evidence of directing a crew to hit a moving target a predetermined number of times. Since trainee performance was observed under simulated conditions, an inference had to be made that similar performance was apt to occur under battle conditions.

Such an inference is not unwarranted. The military is able to absorb millions of individuals within complicated enterprises requiring much specialized know-how, and these individuals usually perform as expected in battle. This is accomplished in the context of relatively short, total immersion type training programs, which are directed by instructors possessing little if any professional education background.

Here is an example of efficient adult education in operation. Literate adults (for the most part) are exposed to performance oriented tasks by instructors who are held responsible for the students' accomplishments. These instructors usually follow clearly prescribed procedures which are aimed at the desired terminal behaviors. Once a trainee successfully completes a program, it is not unreasonable to believe that he will soon be engaged in utilizing it. Hence, the training is immediately reinforced by practical applications. The outcome--effective task mastery by large numbers of adults.

Military training offers an excellent example of how short-term, intensive training experiences effectively modify the behavior of millions of adults. It is one of a number of examples which could be offered.

The example is offered because it involves training strategies apt to violate many of Jung's generalizations.

Jung's generalizations are a step in the right direction. They do lend themselves to validation. Given a sufficient amount of additional inquiry, it is not unreasonable to believe a set of viable generalizations can be derived and utilized as a point of departure by planners of specific training programs. Work reported in subsequent sections of this paper represents one kind of baseline needed to derive pertinent generalizations.

Incidental Training

There is a new field of knowledge emerging in the 1960's which might be described as the "science of knowledge utilization". It is probably misleading, however, to describe this emerging discipline as a "science" at this point in time. In reality, knowledge utilization is at best a crude art occupying the undivided attention of only a small scattering of scholars in three or four centers of learning. There are no schools, no curricula, and few courses for training researchers and practitioners in this area, and there is as yet only a dim awareness on the part of the nation as a whole that this field deserves extensive public support.

Nevertheless, there are two social forces in our contemporary society which are lending an urgency to the development of such a "science". The first of these is the knowledge explosion. Due in part to increased public attention and support, and in part to progress in refining and streamlining the methodology of discovery, there has been a very large increase in the output of basic scientific knowledge. This increase has already outstripped the retrieval capacity of

the typical scholar, and as a result, traditional modes of knowledge organization and transmission are being constantly modified, streamlined and "automated". Because of the potential significance of these changes for the role of the scholar and for the very shape of our society, there is an urgent need to take stock, to evaluate them systematically and objectively, and to trace their implications.

The second force is the growing expectation on the part of industrial executives, government leaders, and the general public that most, if not all, of our storehouse of scientific knowledge should be useful to man. Such an expectation has long been realized in some specific areas such as agricultural extension and in a few of our largest and most sophisticated industrial establishments, but now the expectation extends to many fields: medicine, social welfare, industry of all types, and education. To meet these demands the federal government is becoming increasingly involved in promoting knowledge utilization, and it needs information for the formulation of new policy in this area. Yet government policy makers now have very little on which to base their planning apart from experience in agriculture, and experience which is viewed critically by some and considered irrelevant by others. Policy makers and planners in the various professional disciplines, inside and outside government, have a clear need for "facts"--guidelines based on the best knowledge currently available concerning how knowledge is most readily communicate and utilized.

Work underway to acquire the needed "facts" tends to cluster around three schools of thought about the phases of change: the Social Interaction Perspective, the Research, Development and Diffusion Perspective, and the Problem-Solver Perspective. Although there is some overlap among these schools, they do represent some basic dis-

tinctions which may be made about the process of change.

The first model, the Social Interaction model, is based largely on studies from the rural sociology tradition. Studies included in this category deal with the process by which an innovation is adopted, either by a group or by an individual, once the innovation has already become available to potential adopters. Since theorists of this school are not concerned with the process by which the innovation is made available, they stipulate that the initial stage in the change sequence occurs when the potential receiver becomes aware of the innovation (which may be either a product or a procedure). Subsequent stages describe a sequence of increasing psychological and behavioral involvement, including interest and information seeking, evaluation, trial, and adoption (or rejection). Of special interest to this school are the sources of information which appear to be most influential at each stage of the adoption process. The effect of personal sources of information on the adoption process have been found to be of particular significance. Once the innovation has been adopted by a few members of a group, the innovation seems to spread almost automatically to other members through a process of social interaction.

The second school, Research, Development and Diffusion, begins the analysis of the change sequence at an earlier point in time than does the S - I school, and thus the first stage of change is described by this school as the design, invention, or discovery of an innovation. This first stage is carried out by specialists outside the client system, usually identified as "researchers", "scientists", "developers", or "engineers". Following research and development, with evaluation at each phase, dissemination activities are undertaken

on a large scale. In contrast to the S - I school, the primary attention of the R, D & D theorists generally remains on the efforts of the sender as the innovation is diffusing through the target group. Only secondary attention is paid to the receiver, who is the focus of the S - I theorists. The particular emphasis of this school is on the massiveness of the effort at each of the phases of research, development, and diffusion. This effort must be supported by ample financial resources, and it depends on coordination of personnel with widely varying skills who, in general, are each carrying out only one segment of the total change plan.

The final model, the Problem-Solver, includes studies which focus on the efforts of a receiver in solving his own particular problems. The change sequence is initiated when the receiver (an individual or a group) becomes aware of a need or deficit or when he desires an improvement in his present situation. After a stage of diagnosis, the receiver must locate a solution and make plans to implement it, often with help from outside the receiver system. The innovations may be a product or practice which already exists, or it may be one which is custom-made to meet the receiver's needs. Phases commonly described are: problem awareness; diagnosis; search for and selection of solution; planning for implementation; installation and evaluation; stabilization; and possible diffusion to other groups.

Of especial interest to the present probe is the modification of human behavior that occurs as a result of efforts to diffuse innovations and practices. Training is incidental to these efforts, yet behavioral change becomes an important residual. The table entitled "Some Examples of Knowledge Transfer Events", drawn from Ronald Havelock's, Planning for Innovation, (119) illustrates the phenomenon.

TABLE 1-2

Some Examples of Knowledge Transfer Events

	WHO?	transfers WHAT?	by what CHANNEL?	to WHOM?	to what EFFECT?
EXAMPLES in Education	A team of university scientist educators, and publishers	A new high school science curriculum	Packaging, publication , and setting up training programs	Teachers of nigh school science across the nation	Nationwide acceptance and adoption in majority of high schools
	A social psychologist	Research on detrimental effects of segregated schools	Contributing to a formal brief, and presenting testimony	U.S. Supreme Court	Court decision to ban segregated schools as unconstitutional
	Sociology professor doing research on small groups	A method for systematic recording and analysis of small group interaction processes	Book reporting small group experiments, personal correspondence, exchange of sample materials	Education professor specializing in teaching behaviors	A new system for the analysis of teacher-student interaction in the classroom
	A team of university experts on human relations training, and locally based "inside" change agents	New approaches to collaborative problem-solving on a range of school related issues	Inter-university action research project	All levels of a school system	An internalized capacity for self-renewal and innovation
EXAMPLES in Other Fields	A pharmaceutical manufacturer	A new antibiotic which has proven effective in laboratory and clinical trials	Published reports and reprints, mailed advertising, and office visits by drug "detail" men	Physicians in private practice in the company's market area	Rapidly increasing frequency of prescriptions for the antibiotic among physicians in the area
	Bell Telephone Laboratories	Transistor technology	Coordinated disseminative program using printed literature, manuals, demonstrations, conferences, consultative visits	Electronics manufacturers in several countries	Very rapid adoption of transistor technology and growth of transistor applications
	University research centers studying auto safety	Research evidence that seat belt installation and use is a highly effective means of reducing highway fatalities	Research reports, testimony at hearings, promotion by safety groups	Federal officials charged with administration of safety legislation	Federal standards requiring seat belt installation in all new cars
	Population planning experts	Tested inexpensive and effective birth-control devices	Local health clinics and specially trained local midwives	Impoverished women with large families	Decreasing birth rate and increasing per-capita income in target area
	Agricultural researchers and developers	Hybrid seed corn	Cooperative extension service reports, radio programs, demonstration farms, county agent visits, promotion by seed manufacturers and retailers	Corn producing farms in the United States	Increasing corn yields, increasing farm income
	Cancer researchers and epidemiologists	Close association of cigarette smoking and several major diseases	Research reports, investigations, promotion by American Cancer Society	U.S. Congress and various federal regulatory agencies	Movement towards limitations on advertising and sale of cigarettes

A cursory examination of the table reveals relatively little formalized training. However, quite pronounced effects are obvious. In the first example--a new high school science curriculum--training programs are mentioned. These programs actually are utilized by a minuscule proportion of the adopting high school science teachers; hence, the training is considered incidental to the adoption process in this instance.

Given the emergence of a field described as the science of knowledge utilization, options will increase for strategists who wish to modify human and institutional behavior. Alternatives to conventional training experiences are becoming known which certainly merit attention. These alternatives, in some or even many instances, may prove to be more efficient modus operandi to use.

CHANGE STRATEGIES INVOLVING SPECIFIC TRAINING

Accounts of short-term training programs abound within the field of education. These studies treat all aspects of the training phenomenon, involve a great variety of training circumstances, and generally offer positive adjectives to support work described. One might get the feeling--after reading examples of this repository of information--that a training Valhalla has been attained. Unfortunately, observations of the subsequent performance of individuals exposed to such training would quickly sober even the most optimistic reader of the literature. There appears to be a credibility gap between accounts of training and transfer to the practice of trainees.

Jung's work, mentioned earlier, can be viewed more effectively after surveying appropriate samples from the training literature. First, an overview of training inquiry is described. Then, two variations on this theme are offered: human relations training and the responsive environments project. Finally, military training inquiry is described.

Educational Training Inquiry

Workshops, although not a new concept, were given added impetus by the Eight-Year-Study of the Commission on the Relation of School and College of the Progressive Education Association. (1933-1941) According to Heaton et al. (46), they were suggested for more extensive use by Ralph Tyler and Robert Havinghurst. The advice of these

men was heeded, for the first workshop under the auspices of the Progressive Education Association was held in the summer of 1936, at the Ohio State University. Because of the support of the Progressive Education Association and other reasons, the short term training program approach has become today the largest most common form of in-service training in American education. Many follow-ups and evaluations of these programs have taken place. The following summaries are illustrative of the types carried out.

Heaton, Camp and Didrich (46) followed up participants of a 1939 Progressive Education Association workshop held at the Ohio State University. A randomly selected sample of one-fifth of the participants filled out a checklist and were personally interviewed in order to determine outcomes of the training program. Of the participants polled, 85% had changed course structures, 80% used more democratic teaching methods, 50% were more candidly evaluating their teaching, 68% had renewed interest and faith in education, and 65% expressed having a greater satisfaction in their work.

Otto et al. (47) evaluated four community workshops held at the University of Michigan in 1941. Using diaries kept on a daily basis by participants, and the results of a follow-up letter sent to participants he found that the majority of participants, (1) used new curricular units, (2) were more satisfied with their jobs, (3) had worked on improving community relations, and (4) used evaluative techniques they had not used to assess the quality of their teaching.

The advent of WWII brought the military services, and perhaps even the general public, to recognize the desirability of having available, certainly in wartime, considerable numbers of personnel equipped to speak foreigh languages of military or political importance.

In most cases, this meant that it was necessary to train the requisite personnel almost from scratch, since insufficient numbers had been trained in schools and colleges in critical languages. The "Army" method of intensive language training was developed, largely under the guidance of linguistic scientists, and for the first time in its history, the nation found itself alerted to the possible falsity of the widespread belief that Americans have no aptitude for languages. These "intensive" language learning methods have the drawback of requiring rather large amounts of time. In the program at the Army Language School (ALS) at the Presidio of Monterey in California, for example, the student devotes almost his entire attention to mastering a foreign language during an eight month, or in the case of difficult languages, a twelve month period. The length of the training period is similarly long in programs operated by the Air Force, the Navy, the Foreign Service Institute of the Department of State, and other government departments and agencies. No way has been found to reduce the length of the training program beyond a certain point and still produce a satisfactory and useful product. These are expensive training programs!

George Brown and Alfred Fiks (39) brought much of this work together in a report published in 1967. They present detailed, non-evaluative descriptions of instructional methods used in a sample of outstanding language training centers. Included are 19 different training programs which together represent a student age range from subteens to adults, both intensive and non-intensive courses, military and civiliam students, and governmental as well as nongovernmental programs. For each program surveyed, the report presents fairly detailed description of such features as training objectives: methods

of teaching phonology, grammar, and vocabulary; language laboratory activities; student evaluation procedures; and faculty characteristics. Of the language teaching programs, 15 out of 19 were characterized by their respective officials as adhering to the 'audio-lingual' (A-L) methods. Two key features were shared by the training centers: primary emphasis on aural comprehension and speaking skills, and an inductive approach to grammar.

In order to detect the effectiveness of workshop programs held at the Ohio State University between 1944 and 1947, Henderson (48), evaluated selected programs held at that institution. Using questionnaires and an inventory titled "Attitudes Toward Teaching", she polled 338 teachers, and fifty-five school principals. She found that the "workshops contributed significantly to improvement in attitude in respect to basic understandings concerning democratic teaching". Unfortunately, she also had to report that, "the workshop activities had not resulted in any change in behavior".

An extensive evaluation of a series of workshops was carried out by Kelley (49). After gathering large quantities of data, he made no attempt to systematically study them. He felt that the success of a workshop is determined by the attitudes of participants, and as these were "subjective", they need not be pursued.

O'Rourke (50) evaluated a workshop held in Massachusetts. Choosing six variables (e.g., administrative or supervisory accomplishments, curricular practices, teacher-learning environments, etc.) she measured 261 teachers on these variables with a questionnaire. She found that the participants had improved on all six variables, when compared with a control group.

Not all studies found substantive results. In a loosely con-

structed study, Mills' (51) most profound finding was that "some teachers reported they had gained courage to try new ideas". In the same context of attitudinal change, Mitchell (52) found that "motivation was one of the major advantages of the workshop as an in-service procedure", when a large percent of the group studied stated that workshops awaken new interests and deeper understandings of old ones. Another study done that substantiates these findings was one done by Decosta et al. (53). They found, in reviewing evaluation sheets filled out by participants, that frequent references were made to the inspiration which they felt they had gained and the general benefits they felt would come to others from their efforts.

Large city school districts have initiated massive workshop programs as the principal mode of in-service education for their teachers. Examples of these are the Detroit, Michigan, and Philadelphia, Pennsylvania programs, As of 1962 there had been 380 workshops held in the Detroit school system with little evaluation of them. Some evaluations have taken place, however. Marburger, (54) in an evaluation of a Detroit workshop, concerned with the disadvantaged, found that "attitudes of participants toward the disadvantaged were enhanced as a result of their in-service experiences".

More sophisticated attempts at evaluation have been done. Gruber (56) studied nine academic year institutes offered at the University of Colorado in the years 1958 and 1959. His was an honest effort to find if Fellows enrolled approached science teaching as a set of established facts and doctrines, or as a way of thought.

One of the main objectives of the institutes was to have trainees view science teaching as a way of thought. His findings and recommendations for future institutes are quite illuminating. He found that

"at the end of the training year, only 25% of the Fellows were rated strong in their concern for teaching science as a way of thought, and over 60% showed negligible interest in this aspect of science".

As a means of overcoming this lack of effectiveness, Gruber recommends more leisurely discussion on the part of participants because "the number of hours devoted to academic work per week was negatively correlated with the criterion variable, (good lesson plans) suggesting that a certain amount of leisure for thoughtful discussion of the meaning of science was more important than a large amount of academic busy-work". His only recourse from this finding was to recommend "that training programs stressing active participation by the Fellows, may lead to an approach to science teaching in which science is treated as a way of thought".

Gruber et al. (57) evaluated another Academic Year Institute in 1959, in which they found that it "failed to transmit attitudes and information relevant to teaching science, not only as a body of knowledge, but as a way of thinking".

Stevenson (58) in his study of the Academic Year Institute at the Ohio State University, attempted to measure the nature of the changes which occurred in the participating teachers, the nature of the changes which occurred in the school systems to which they returned, and the extent to which the changes were attributable to the Academic Year Institute. Using a questionnaire on both participants and their immediate supervisors, he found that participants signed up for more professional courses than their colleagues, their supervisors said that participants were better teachers because of their experience, participants had to a considerable extent changed their teaching methods, and that they influenced their colleagues in a

constructive manner.

Another evaluation of an institute at the University of Wisconsin was undertaken by Heidman (59). His study took place three years after the program took place. He followed up participants with questionnaires and interviews, and found that participants had: (1) profited by their training, (2) improved their professional attitude, (3) increased their confidence and security, (4) increased their occupational mobility, (5) removed academic deficiencies, and (6) modernized their teaching methods and concepts.

The impact of the National Science Foundation on high schools was pointed out by Ronald F. Campbell and Robert A. Bunnell (60). They studied National Science Foundation regular term and summer institutes as influences on the high schools of Illinois in terms of two variables, socioeconomic level, and location of the school community. By sending a questionnaire to all superintendents of schools in Illinois, he found that those communitites with populations classified as having high socioeconomic levels had: (1) greater participation by science teachers in National Science Foundation programs, (2) more course offerings, and (3) displayed greater awareness of latest curricular changes. They also found that: (1) suburban schools had the highest participation of teachers in National Science Foundation programs, (2) they also had the highest number of curricular changes taking place, and (3) urban schools ranked highest in the number of courses added just prior to the study.

Ivor (61) completed a study of National Science Foundation participants under the auspices of Social Science Research Incorporated. A cooperative research project, United States Office of Education Series was reported by Gerber (62) regarding a 1962 Institute in

English. In both these projects a positive effect on participants was found to be evident. The impact varied from the general "just made me a better teacher", to the more specific "acquired up-dated subject matter".

In order to determine the impact of National Defense Education Act, Title III in-service programs, Johnson (63) conducted a comprehensive study of all such programs for the California State Department of Education. When asked to judge the importance of eight factors considered significant in affecting the quality of teachers, administrators ranked National Defense Education Act programs second only to "quality of preparation". Johnson also found that because of Title III, "five out of six administrators felt that the teachers in the schools were significantly more effective as directors of classroom instruction". After analyzing his data, Johnson was led to conclude that "these institutes have been the greatest impetus for change in the history of education".

In another evaluation of Title III programs, Marshall (64) in his study at Indiana University attempted to determine what changes in science education in the public schools of Indiana had been effected by the local school district's Title III science programs. He found that: (1) participants and their supervisors were enthusiastic about benefits received from the training, (2) knowledge and techniques gained in the institute training might have been a factor in the participants taking on responsibilities and duties in the local Title III programs, and (3) more communication was needed between science teachers and the state Title III office.

A 1962 Michigan workshop for Language Arts teachers was evaluated by Karbal (65). His method of inquiry included sending questionnaires

to, and holding personal interviews with, all thirty-seven participants. He found that because of the workshop experience, "most teachers were anxious to do something definite in the schools". He also found that the majority of the administrators and immediate superiors of the participants thought them better teachers, more active, and more anxious to participate.

Similar findings were reported by Petrongolo (66) in a study that evaluated participants who had attended National Science Foundation summer institutes from 1961 to 1966. Using a questionnaire and a Director's report as data sources, he analyzed returns from 227 participants. Teachers considered it "worthwhile", and a "big help". Teachers also thought that they: (1) grew intellectually, (2) used knowledge gained at the institute in their teaching, (3) changed their teaching procedures, and (4) were better teachers.

A more sophisticated analysis was done by personnel from the Center for Instructional Research and Curriculum Evaluation on the 1966 American Educational Research Association pre-session on experimental design (67), Using various data gathering devices and achievement tests, the investigators found, among other things, a substantial gain in knowledge about design and analysis. They reported little change in participants attitudes toward research activities.

During February 1 to 5, 1969, the AERA conducted a similar program of eight research training presessions prior to the annual meeting of the Association in Los Angeles. Approximately two months later, March 28 to April 1, four research training postsessions were staged by AERA in College Park, Maryland. The combined meetings served 542 individuals.

A standard evaluation form was administered anonymously at the close

of each meeting by independent persons under the direction of W. James Popham (68). He reported a very favorable participant response to the overall program. It seems that approximately 90% of participants who responded were well satisfied with the programs.

Perceptions of behavioral changes effected by a training program in human relations held at Michigan State University in 1966 were studied by Krafft (69). He found that training participants indicated a highly significant perceived behavioral change as they functioned on-the-job, six months following the workshop.

Bradberry (70) followed up participants of National Science Foundation Institutes held at six southeastern universities between 1959 and 1961. Using a questionnaire as a data gathering device, she concluded that: (1) 71% of the participants had revised course content, (2) 80% had varied their teaching presentations, and (3) 72% were using the problem-solving method in their teaching. In sum, she found the conferences most beneficial.

In a study done at the same institution, Hand (71) evaluated a mathematics institute which was basically a comparison of the mathematics achievement of participants as compared to a control group of non-attending teachers, and a comparison of the mathematics achievement of the students of the two above mentioned groups. In both cases the participant and his students scored significantly higher than their control groups in mathematics achievement.

Two other less rigorous studies have been done recently in the southeast. Irby (72), and Rasmussen (73) both evaluated institute programs that were held at the University of Mississippi, and the University of Georgia, respectively. Both used questionnaires, and both found the effects of the programs worthwhile and beneficial.

The most rigorous evaluation of an institute has been done by Wilson (74). He analyzed data gathered from participants of seven week institute held for teachers of the disadvantaged. Using a validated questionnaire titled "Your Perceptions of the Disadvantaged", and highly sophisticated analysis of covariance statistical techniques, he found, "there were significant differences (p. = .001) between the experimental and control groups in regard to their perceptions of the disadvantaged". A recommendation generated by this study was that other studies be done on the influence of institutes and in-service programs on the perceptions of their participants.

A further study of an institute for teachers of the disadvantaged was done by Fischle (75). Evaluating a 1966 institute held at Ball State College, and using the Minnesota Teacher Attitude Inventory, and the Personal Orientation Inventory and instrumentation, she determined significant differences (p. = .01) in teachers attitudes toward the disadvantaged when pre-conference scores were compared to post-conference scores. Practice effect was not considered when analyzing the data.

The effectiveness of summer science training programs (SSTP) for high ability secondary school students was investigated by Edgerton (76). Questionnaires were used in a study 3 years after completion of the program to compare the subsequent academic progress, career choices, and science-related activities of SSTP participants with those of participants in the Westinghouse Science Talent Search (STS) and a group of peers selected by teachers and school administrators. SSTP participants, who had rather firm career plans prior to participation, reported the program either made no change or refined and intensified their plans for a science career. The majority

reported beneficial effects of the SSTP on their subsequent high school work. Many reported improved work habits and increased interest in science. About 68% of the SSTP participants listed science and mathematics careers as their first choice. A greater percentage of the SSTP participants selected science majors in college and received superior college grades than did those included in the STS and the peer groups.

A report is given of the first 3 years of a field study conducted to determine the effectiveness of several prototype, secondary mathematics programs that were produced by different curriculum development groups by Erickson and Ryan (77). Mathematics teachers who had no previous experience with "modern" or experimental approaches to mathematics taught a selected grade level class with conventional materials for one year, and in the following year taught two classes of the same grade level, one with the conventional methods, and one with an experimental curriculum selected by the teacher from those available. Some teachers taught a conventional class and an experimental class using the same experimental materials at the same grade level for a second year. Pupils were randomly assigned to the classes.

Effectiveness of the experimental curriculum was measured by a pre- and post-test measure given at the start and end of the year of study and again at the start of the following year as a means of measuring retention.

Results of the study showed there were few statistically significant differences with respect to mathematical achievement and retention between students instructed with each of the experimental programs. Significant teacher differences occurred for all curriculums. Initial pupil ability was, by far, the most significant factor involved in either the achievement or the retention studies.

Five summer, 1966, pilot institutes at five universities, attended by 190 elementary and secondary civics teachers, were judged worthwhile by Longaker and Cleary (78). These institutes were sponsored by CONPASS, a Consortium of Professional Associations for the Study of Special Teacher Improvement Programs. However, deficiencies were found in (1) scheduling, (2) utilization of literature (current political science literature was not used to good advantage), (3) transfer and translation (the institute staffs often failed to show the teachers how the work they were doing could be incorporated into daily teaching). No meaningful quantitative data were offered for use in evaluating these programs.

Among the proposals for improving institutes were:

(1) teachers should be encouraged to see the institutes as a means of furthering their education, rather than as one-shot affairs;

(2) institutes should be distributed geographically by subject matter;

(3) participants should be given an allowance for book purchases;

(4) methods should be identified for overcoming the problem of transfer and translation so that teachers could help their students to comprehend the processes of government and the uses of political power.

It is also recommended that a continuing institute be funded--teachers would participate in a summer institute, take back to their schools a reading list and a program of application of what they learned, attend two conferences during the school year, and finally attend a second summer institute.

An evaluation of 34 institutes under the NDEA for Advanced Study

in Reading was conducted by Stauffer (83) for the IRA to elicit information in the following areas:

(1) congruence of program with details of the original proposal,

(2) effectiveness of the implementation of program content

(3) efficiency of administration

(4) appropriateness of the physical conditions.

The institutes varied in length from four to eight weeks and involved from twenty to eighty individuals.

Systematic efforts were made to carefully study these institutes. A variety of measurement techniques were reported by most institute directors. Post-tests and pre-tests were reported in addition to final papers, group presentations, individual projects, informal evaluation, and discussion. Furthermore, visiting teams conducted interviews with institute directors, staff members, and participants with the aid of check lists. Since program plans were generally vague and not emphasized during pre-institute planning sessions, these various measurement attempts fell short of intentions sought.

Evaluative evidence was reported from the vantage point of program directors, participants, and overall project evaluators. Program directors believed the Reading Institute to be an excellent approach to meeting the needs of teachers in the various geographic areas, with the qualification that additional institutes of similar type would be necessary if maximum benefit were to accrue from such a problem. They felt that one other good way to effect change in reading instruction would be Reading Institute programs for principals and supervisors. Participants reported that Institutes should declare only one or two objectives and should concentrate on the attainment of these objectives throughout. Participants should know clearly

what the objectives are, should refer to the objectives constantly, and should help determine whether or not and to what degree the objectives are being attained. Doubt was expressed by the program evaluators as to whether the participants were sufficiently capable people to provide leadership in their home schools either by demonstration of skills learned or by informal discussion. If Institute participants are expected to be potential influences of instructional practice in school systems, the selection criteria might well be re-examined. The concept of new material and information also needed reexamination in order to be meaningful.

A final study, conducted by Leary (84), is included because it raises especially pertinent questions about investigations of the effectiveness of training programs upon the practice of participants. Specifically, the study attempted to relate selected program intentions to participants' practice in two ways: the extent to which selected training programs are recognized by participants as sources of information about educational innovations; and the extent to which they are recognized as sources of information contributing to the adoption of innovations. Program attendance, source of support for program attendance, program subject matter, and participants' judgments of the worth of programs attended were identified as the factors to be studied. Data were obtained via an inventory prior to, immediately following, and six months after the programs.

Selected short-term in-service training programs on innovations sponsored by the Institute for the Development of Educational Activities (I/D/E/A) and by the University of Massachusetts constituted the study sample. The rationale for selecting these programs was proximity on the part of the researchers.

The 1000 participants in the 1967 I/D/E/A Hawaiian Seminars received only the third inventory, the 400 participants in the 1968 I/D/E/A Institutes on Innovation received all three inventories, while the 400 participants in the 1968 University of Massachusetts Workshop on Flexible Scheduling and Innovation received all three inventories.

Four conclusions were gleaned from analyses of data obtained. First, the programs were more effective in influencing participants' awareness of innovations than in influencing their decisions to adopt innovations within their practice: 29% reflected awareness, whereas 11% revealed adoption. Both percentages significantly exceeded limits set forth. Second, the mode of support for conference attendance--i.e., personal expense or agency expense--did not influence participants' reactions to the programs or their behavior as a result of them. Third, innovations treated within the programs were significantly related to innovations of subsequent interest to program participants. Fourth, there was no difference between participants' attitudes toward the programs--i.e., their appraisal of the program's value at the end of the sessions--and their subsequent behavior. Profiles of innovation awareness and adoption were not related to participants' appraisals of the programs. When these conclusions are related, and overarching conclusion emerges: the programs generated more awareness of innovations and more actual innovation adoption than was expected, but these outcomes could not be directly attributed to the nature of the programs considered.

Short-term in-service training programs, such as those selected for study, seemed to influence participants' awareness of innovations and decisions to adopt innovations. This observation certainly supports the continuation of similar programs in the future. However, partici-

pants' attitudes toward the worth of these programs raises four questions about the nature of the programs. First, what did the programs specifically offer the participants which influenced their behavior? Second, given a common experience, why do so few participants recognize its influence? Third, why do so few participants modify their attitudes and practice as a result of the experiences? Fourth, what accounts for similar attitude and adoption profiles of participants who view the experiences in diametrically opposite ways? Answers to these questions would undoubtedly enhance the influence of this mode of in-service training.

Clearly setting fourth purposes for training, then selecting participants apt to profit from these intentions, and finally, following up the training within the context of the participants' practice, seems in order. The logic of these suggestions is so obvious, one can only wonder why so few training program planners take them into account.

Finally, this study suggests more rigorous methods of ascertaining the efficacy of short-term training programs upon the attitudes and behavior of participants are needed. Simply surveying participants' reactions to the program at its conclusion just does not offer much useful information. Such a technique overlooks what a participant brings to the program, and it ignores the program's impact upon subsequent practice.

Studies of short term training programs take basically three forms. Many large sample studies of training programs take the form of descriptive accounts of the calibre of the program itself. A second form of training program evaluation involves measures of the acquisition of subject matter by the conference participants. These studies usually report very impressive results. The findings of this type study usually show "substantial gains", "significant increases", etc. A third group

of training program evaluations are ones that measure participants' and sometimes their administrators' opinions on the worth of the program. These studies often follow-up participants into their practice. Results normally take the form of large percentages of the sample, saying they have changed teaching methods, added new presentations, or are "better" teachers for having attended.

Taken as a whole, the evaluation of short term training programs contains all the inadequacies that plague much of educational research. In many studies little, if any, effort is made to randomize, control intervening variables, and control for selection, practice effect, maturation, or regression to the mean. Follow-up studies violate too many research conditions to be useful. This is not to fault all of them, because there are examples of sincere inquiry efforts reported.

Human Relations Training

Some industrial organizations in Canada and the USA came to the conclusion after WWII that leaving personnel development and training in human relations to chance is costly. For the past two decades a variety of training programs have sprung up in industry. The training goal has been to help the student to become more effective and responsible in working with and through people. The aim has been for him to acquire the capacity to respond effectively in human situations.

Schutz (85) points out the similarity of the historical development of training programs in diverse fields such as industry, psychotherapy, and education. These fields initially employed a more traditional method (lecture or group discussion), but ended up facing the here-and-now, the immediate existential encounters of group members.

One of the first company sponsored training programs, the Alcan Corporation's, dates back to the late Forties. At the time the organization faced the problem of attracting and integrating more than 100 university graduates a year who, as a result of the shortage of reserve in managerial ranks and the attrition of its cadres during the war years, were to occupy administrative positions on joining the company. An initial program evolved around lectures covering such subjects as industrial sociology as well as the more traditional topics, including the history of the company and its corporate organization. It soon became evident, however, that these imposed lectures gave "answers" to no questions raised explicitly or implicitly by the group.

By the early Fifties the case method and, to a much lesser extent, role playing were adopted as ways of teaching administraion and human relations. Concurrently the composition of the student group changed. Supervisory personnel with five, ten, or twenty years' experience replaced young university graduates in the class. Cases reflected actual administrative situations involving people, their thoughts, assumptions, attitudes and behavior.

Class discussions offered simulated business experiences. It was hoped that through discussions and confrontation of ideas, the participant became somewhat more aware of his own generalizations about human behavior and that this helped him to reexamine his own attitudes and assumptions.

Unfortunately, little or no difference was noticed in the participant's behavior in his back-home situation, and little or no evidence was found of his attempting to experiment with a different style of behavior. Perhaps this should have been anticipated with the method used. When there is limited group self-analysis, when most inter-

action is channeled through the instructor, when the discussion material is "out there", the opportunity for expansion in depth is rarely available to the student.

So the T Groups were born. From a slow beginning in the early Sixties, the concept expanded steadily. It now comprises a variety of forms ranging from several days in length, to several weeks, to continuous operation type laboratories.

The case discussion offers the student a simulated business experience. The T Group is an analogue of life itself. It is concerned with the immediate existential confrontation, the here-and-now experience rather than a case "out there". One can no longer hide oneself behind characters in the case; one can no longer too easily hang somebody in effigy. One becomes involved and immersed in a "real" situation.

A T Group may be seen as operating on two levels. The first is the evocative one, the level of emotions, feelings, and sentiments, a Dionysian model, somewhat nonrational and regressive, the second is the rational Apollonian model, which allows the participants to understand, rationalize and incorporate. Compared with case discussions, a T Group is considerably more engaging and involving. The T Group's members are both investigators and subjects of the learning experience; they are both participants and observers.

Although little or no attempt has been made to quantify the effectiveness of the basic T Group concept, its impact has begun to be felt. There is accumulating clinical evidence which supports continuation of T Group training within the company. As might have been expected, the experience affects the individual where his relationships with others are most crucial, where he is most involved in a deep personal sense, where his ambivalent feeling has the strongest resonance.

Unfortunately, the over-all results of human relations training are questionable, at best, for on-the-job practitioners. Individual benefits are thought to be great, and personal testimonials are abundantly favorable. Attempts to apply behavioral science research strategies to the problem are indeed scarce.

One such study reported in the literature in 1964 does stand out. Robert R. Blake, Jane S. Mouton, Louis B. Barnes and Larry E. Greiner (86) conducted a study which has become a classic within the field of organizational development. Reported in the Harvard Business Review, the study focused upon how behavioral science concepts of team learning form a link between individual learning and total organization development. The link is important because it suggests some answers to a long-standing problem in industry: how to test and demonstrate the large-scale usefulness of human relations research and teaching. A new approach to management development and, more broadly, to organization development is also described.

The experiment made use of a "Managerial Grid" approach to more effective work relationships. The Grid helps to give businessmen a language system for describing their current managerial preferences. It also involves classroom materials and an educational program for designing more productive problem-solving relationships. Even more important, the program is meant to be taught and applied by line managers over a time span involving six overlapping phases.

The evaluation took place in a large plant (about 4,000 employees), which was part of a very large multiplant company. The parent company will be called "Piedmont" and the relevant plant unit "Sigma," for purposes of disguise. The Sigma plant had a reputation within Piedmont of being technically competent and had consistently been able to meet

production goals over past years. Among Sigma's 4,000 employees were some 800 managers and technical staff personnel. These managers and staff personnel were all exposed to a Managerial Grid training program beginning late in 1962. At the request of the research manager in Piedmont's employee relations department, an evaluation study was designed shortly thereafter to follow up the effects of that program. The study included questionnaires, interviews, observations, and a combing of company records in order to separate program effects from nonprogram effects. The findings suggest that, even allowing for the nonprogram effects, the results of the Grid program were impressive. In brief:

- There is some evidence that Sigma's organization development program was responsible for at least several million dollars of controllable cost savings and profit increase. In addition, the program seems to have been responsible for a sizable increase in employee productivity during its first year.
- Sigma's managers began follow-up projects having total organization implications to a degree never experienced prior to the organization development program.
- The relationships between Sigma and Piedmont were considerably improved, partly as a result of the program. In addition, both union and community relationships were better than they had been in the past.
- There is some evidence that major shifts occurred in the behavioral patterns, dominant values, and attitudes found among managers at Sigma. These shifts were in line with the goals of the Managerial Grid program. Improved boss-subordinate, group, and intergroup relations were reported by Sigma managers.

- Colleague support seemed to be more important than boss support as a factor in managerial improvement, according to subordinate managers.

The lessons from this study also involve a number of implications for businessmen. Initially, it does appear that behavioral science and human relations education can assist with large-scale organization development under certain conditions. These conditions, as suggested by the data, include:

- Demanding but tolerant headquarters.
- An enthusiastic and involved top-manager and senior management group.
- Educational strategy that effectively and continuously builds team problem solving and mutual support into work-related issues.
- An organization whose work requires some interdependent effort and common values.

This study suggests that managerial and team effectiveness can be taught by managers with outside assistance. Furthermore, it appears that this type of educational strategy can help to make significant contributions to organizational effectiveness. This in itself seems to be an important lesson for management to recognize and use in its future efforts to build stronger organizations.

Follwing the direction of this study, Fred Massarik ( ) attempted to develop a comprehensive framework to order existing sensitivity training research and guide future research efforts using a sensitivity training impact model (STIM). This model considers three sets of human exchange through time-penetration, training, and post-training experience. STIM follows the initial total population, preselecting potential participants, th selection funnel through which some of

them move before becoming ready to take part in the program, and the intake process leading to final selection.

Both for trainees and trainers, key psychological and social variables to be considered in research are classified in terms of an interpersonal matrix and an intrapersonal matrix. The matrixes provide measures of training outcomes for individuals and for larger social entities, such as organizational, family, and friendship relationship patterns.

The model set forth has not yet been systematically tested in an operational setting, unfortunately. Nevertheless, Massarik has offered trainers a systematic tool for use in their work.

A comprehensive review and integration of the major empirical literature on organizational development practice was presented by Froman and Sashkin (40) in 1970. Covered are the managerial grid, survey feedback procedures, sensitivity training, and socio-technical systems approaches.

Generally, the work cited suggests something exists worthy of pursuit, but it offers little help in either setting a course or attaining the desired outcomes. Too much of the training is amorphous at best; hence, researchers are unable to draw parallels among intentions, training, and performance. If there is a pattern emerging within this training tradition, it is definitely toward more structure.

The Responsive Environments Project

The long-range objective of the project (88) is the creation of an experimentally grounded theory of human problem solving and social interaction. The present proximate goals are: (a) to construct new formal systems which, hopefully, will be of use in formulating such

a theory, (b) to design equipment in accordance with the principles of the theory, both to facilitate testing the theory and for educational applications, (c) to formulate heuristic principles which may prove helpful in guiding empirical investigations, and finally, (d) to test parts of the theory as they are formulated. Only points (a), (c), and (d) are amplified in the following pages as they bear most directly on the problem being treated.

About ten years ago, a task force at Yale University undertook the ambitious task of finding out what was wrong with the behavioral sciences; what did these sciences require to accelerate their development? It came to the conclusion that, among other things, the behavioral sciences needed additional formal machinery to handle some of the concepts peculiar to them. In this section three kinds of new logical systems which seem to be of relevance to the problems under consideration were considered.

I. Deontic Logic: the logic of obligation, permission, prohibition, and related notions. Normative aspects, or rules, of the environment are of central importance for the interpretation of human interaction, yet almost no mathematical techniques were available for treating this idea. To the best of the group's knowledge, the only inquirers ten years ago who were willing to gamble on the idea that logic in general, and deontic logic in particular, had a direct and immediate bearing on the analysis of social interaction, consisted of the group at Yale. Even today, now that deontic logic is a going concern, the motivations of most mathematicians and logicians who work on it outside of the group are either solely formal or solely philosophical. The group shares these concerns, but has its eyes on the behavioral sciences as

well.

Whenever an experimenter plans a new environment--an environment in which preschool children learn to read and write, for example--the planner is faced not only with the obvious problems of designing the physical layout, including whatever special equipment is to be employed, but he also faces the fact that he will have some normative system which is to provide the "rules of the game" for entering the environment, for behaving within it once there, and for leaving it.

The group contends that if the experimenter does not take the normative aspect into account it will almost always emerge as a major source of unexplained variance in performance. Clearly, for instance, a situation in which the subjects of an experiment are virtually prisoners to the experimental situation, permitted to do only what the experimenter orders, is deontically very different from one in which the subjects may refuse to come to the laboratory at all, may stay as long as they wish, and may leave whenever they wish.

There are, both in theory and in practice, considerable variations in the deontic systems that human beings use. Unless the group has some way of analyzing the formal structure of these systems, it can characterize neither the norms which subjects bring to a laboratory nor the laboratory's own norms, to say nothing of the possible changes in normative structure which might result from exposure to an experimentally contrived environment.

It develops that the deontic operations referred to at the outset are definable in terms of other model operations, in particular, what have been called the alethic modes. These have to do with necessity, possibility, contingency, and impossibility. The literature on the topic contains many discussions of how this is to be done. But the

leading idea in each case is the same: one says that it is obligatory that p just in case the falsity of p leads to some violation of the set of norms or rules in which we are interested. Other properties of the deontic concepts then emerge with the help of standard logical techniques.

Given these operations, one can characterize social systems such as authoritarianism: one is permitted only to do one's duty, there are no indifferent states-of-affairs, everything is either obligatory or forbidden; conflated ethics: what is permitted is what is possible, all states-of-affairs are ethically indifferent or neutral, the only thing that really matters is either what we can do, or else forbidden events are simply ignored. Cusinism: what is necessary is, and what is is possible, but what is obligatory is not necessary, and what occurs is not necessarily permitted. One aim in mentioning these examples is to point out that there exist systems of mathematical logic which might help us better understand the formal properties of various normative systems.

II. The Logic of Relevance. A second problem which seemed pressing in the context of analyzing social interaction was the notion of the relevance of one proposition to another. Classical truth-functional, alethic, and deontic modal logic take no account whatever of the notion of relevance as between antecedent and consequent of an "if . . . then---" statement. The connection with social interaction is as follows. Certain social situations are less "structured" than others in terms of the relevance of one utterance or action to another. As extreme cases we might consider the word-salad of psychotics, as compared with a well-conducted criminal trial or an argument contained in a scientific

monograph. In the first case almost anything goes; in the second, elaborate preparation is sometimes required to justify the relevance of a certain line of inquiry or reasoning to the issue at hand. The group would like to suggest that just as the normative structure of an interactional situation is one important aspect of social interaction, so also are the canons of relevance which help determine the character of the interaction of members of a group.

Building on the work of a fundamental and very important paper by Ackermann (1956), a number of investigators have done work on the problem of relevance from the point of view of mathematical logic.

III. Erotetic Logic: the logic of questions and answers. There is another aspect of the problem of characterizing mathematically the forms of social interaction which seems of equal importance. Any account of human symbolic interaction should certainly take into account the logic of interrogatives. This field in modern form is very recent; the most definitive study to date is that of Belnap, and though not directly connected with the Responsive Environments Project, it is sufficiently close in spirit that the group does not hesitate to claim that Belnap's work has an immediate bearing on the kind of formal work associated with this project.

IV. Projections. The initial impetus for the development of all these systems was philosophical in character. Yet the formal systems--once set forth--proved of interest from a purely mathematical point of view. Standard mathematical questions about completeness, consistency, decidability, etc., could be asked about them, and in many cases these questions have been answered. Moreover, some of these

structures turned out to have close connections with other parts of mathematics which were developed earlier with entirely different motivations.

Those of us associated with the Responsive Environments Project share the philosophical and mathematical interests in the formal systems considered above; such novelty as lies in our approach depends on our belief that the systems could also be useful in constructing some sort of abstract characterization of various important aspects of systems of social interaction. Such applications are largely programmatic, but noticeable progress has been made in relevant areas of alethic modal logic, deontic logic, the logic of relevance, and erotetic logic in the pastten years. The group does not see in the immediate future any direct application of these formalisms for the description or construction of systems dealing with human interaction. It may prove that the formal developments are valuable for the behavioral sciences only as heuristic devices which enable one to gain some clarity concerning the concepts involved. But the following considerations may make the projected applications look somewhat plausible.

It seems reasonable to conjecture that anything one would want to consider as a "social group" would consist of individuals who share beliefs about (a) what sort of thing is possible, necessary, etc., (b) what is permitted, obligatory, etc., (c) what is relevant to what, and (d) what sort of questions are to be asked and how they are to be answered. Under I-III above, the group has noted briefly some examples of alethic, deontic, relevant, and erotetic logic which might be applied in describing such a social group.

If one is engaged in contriving, rather than simply describing, an environment, experience suggests that <u>any</u> guidance one can get from

theoretical considerations such as those outlined above is enormously useful. In this sense these systems have already proved to be helpful as extremely abstract "blueprints" which, when superimposed on one another, give one some guidance in making real the kind of environments which lead to almost unexpectedly dramatic results.

The group wants to discuss a very important, and an easily overlooked, aspect of the Project's empirical work: namely, the set of rules governing the operation of a laboratory. Generally speaking, machines are more accurate than humans, and they take much of the drudgery out of the actual running of a laboratory, but machines are not nearly as essential to the project as the set of rules surrounding the environment. Sensitivity to the stimulating and autotelic features of an environment requires at least as much managerial skill and concern for the "customer" as is required to run a good restaurant: trained, knowledgeable persons in a position to prepare and dish out intellectual nourishment in a manner sufficiently appetizing so as to get the customers to return of their own volition. The laboratory situation is unlike that in ordinary schools where the law requires attendance. As mentioned earlier, children are invited (not ordered) to come to the laboratory, and to date have not found a single child among those to whom laboratories under this project have been available, who has persisted in refusing to come. The group attributes this fact in part to the truly invitational character of the invitation; and it is because (the group suspects) that the laboratory environment is stimulating, autotelic, and responsive, that the children keep returning without the coercion of a truant officer.

Exploratory Investigations. The period from about 1958 to 1966 has been spent in preparing for large-scale, rigorously designed

and executed experimental studies. This preparation has taken the form of numerous "quick and dirty" pilot investigations, designed to answer questions as to the feasibility of the whole enterprise. In order to give the reader a sense of the exploratory studies made to date, a few are listed:

(a) Mechanics. From early 1961 to 1966, the talking typewriter went through many prototypes and three major models, pilot studies being geared to the questions, "Do children like it?" "Is it (nearly) indestructible?" and "Can the laboratory managers operate it?" For each question the answer seems to be, at this writing, "yes".

(b) Architecture. Since 1958 several laboratories have been designed and constructed; four are now in existence, and two more are in the planning stage. Since the group is dealing primarily with very young children, it is not feasible at the outset to lecture them on the autotelic character of the laboratory environment; but it has been found very useful to use every possible clue to bring home the point that when they pass through the door they are entering a new environment, where the rules of behavior are different and which is in some sense cut off from their everyday world. This sharp demarcation can be pressed by using different colors, floor textures, temperatures (the laboratories are air-conditioned), and so on. Again, the exploration has been aimed at finding the ideal--so that children on entering the laboratory will know that they are in a "different world".

(c) Selection and Training of Staff. For reasons which we do not understand very well, our most successful laboratory assistants have a high degree of interest in matters esthetic. This seems odd in view of the stereotype according to which interest in esthetics precludes interest in machines; although, of course, a piano is a

sound-producing machine. The group hopes to speculate on this matter on another occasion; for the moment, it simply notes that it guides the selection of trainees and that the fact is compatible with a view of the importance of autotelic folk-models.

Among the other aspects of the training program, it was noted that professionally trained, experienced teachers meet needs for laboratory supervisors very well; and in turn they find the connection with the new educational technology to be stimulating and satisfying. Further, very little time is required--a day or so--to master the relevant mechanical details of the machinery itself; what takes time is to internalize the rules designed to ensure that the environment remains stimulating, autotelic, and responsive.

(d) Curriculum: Content. A survey of the extensive literature on the topic of reading curricula revealed that on the whole this material was not suitable for study purposes, both because it was not designed for preschool children, and because it was not sufficiently flexible for use with the wide variety of children (gifted, normal, retarded, culturally affluent or deprived, deaf, epileptic, etc.) whom the group hoped to study and possibly help. The tack taken since 1958, then, is to elicit material from the children on an individual basis, making use of their conversations with adults and with other children, and such other ways of expressing themselves (pictures they draw, for example) as can be readily picked up by a sensitive adult's ear or by recorders. The result is a list of topics, sentences, and little stories, derived from a variety of encounters, which are almost bound to match the child's level of sophistication, understanding, and interests. This information is evaluated by the laboratory supervisor, then encoded by the programmer. The child is not, however, confined

solely to his own productions; from time to time he is introduced to material outside his ken, and perhaps slightly more difficult than what he creates for himself: he is exposed to the programs of other children in his group, or more advanced groups; and he is given a few "set pieces" chosen by those in charge from appropriate literary classics such as Aesop, Lewis Carroll, Robert Louis Stevenson, A.A. Milne.

(e) Curriculum: Organization. The group began by making some impressionistic observations concerning the four basic aspects of communication of concern and the social contexts in which these occur, as expressed in the table:

	Speaking-Listening	Reading-Writing
Formal	Lectures; after-dinner speeches; set pieces; plays, monologues	Articles and books of an expository nature; non-fiction
Informal	Daily colloquial talk; party chitchat; use of "ordinary language"	Personal letters; dialogue in fiction; humorous writings; diaries

Experience suggested that the bulk of the population is pretty much confined to the lower left quadrant; one of the principal aims has been to try to keep a parallel between writing (as visible speech) and speaking (as audible writing), an attitude designed to create in children the view that reading-writing and speaking-listening go hand in hand; one is as natural as the other.

In addition, since 1958 the group has been developing and testing various ways of helping achild become familiar with the English notational conventions which will enable him to map orthography onto speech, in order to introduce the child to punctuational conventions and physical

arrangement such as spacing between words and paragraphing at the same time as upper- and lower-case letters. Thus the child neither ignores punctuation in learning to read, nor is he faced with the sudden need to sprinkle these marks throughout his sentences when he begins to write.

The environments through which children are led from notational conventions, through words, sentences, and paragraphs, to books, are stimulating in the sense described above. At each stage of development, a child is in a position to run his current activity through any of the four perspectives discussed earlier. The aim of the whole program is to organize environments so that in any session a child can take any of the four perspectives, or any combination thereof, independently of the level of sophistication or competence at which he is working.

In the course of the pilot studies intended to prepare for rigorous experimentation, the group has been able to arrive at some conclusions and conjectures about children.

(1) The children were uniformly given a battery of examinations before entering the program: general physical examination, eye examinations, ear examinations, and evaluation of the child's speech development, and examination of the child's emotional health by a clinical psychologist, and standard I.Q. tests. In addition, home interviews were conducted in order to obtain child development histories and information concerning the socio-economic standing of the families. All tests and examinations were repeated regularly at appropriate intervals, and all were carried out by medical, psychological, and sociological specialists. The base-line data and continuing examinations have thus far indicated no untoward side effects; but no children were taken who for foreseeable pediatric or other reasons (such as parental disagree-

ment over the advisability of sending the child) might be in some way injurious. Evidence seems to show that the primary and secondary effects of the sort the group's heuristics would lead to expect, are positive.

(2) Speed of learning reading and writing in the laboratory seems to be positively correlated (as theoretical views would lead to expect) with the maturity of the speaking-listening abilities the child brings to the laboratory.

(3) Ordinarily there is a high positive correlation between I.Q. scores and excellence of speech as assessed by speech experts. Children who enter with high ratings on both scales do better than those with lower ones. In the two cases of discrepancies (high I.Q. and low speech, and low I.Q. and high speech), under the influence of the program I.Q. seems to more rapidly approach speech than speech approaches I.Q. The reason apparently derives from (2): if strong speaking-listening habits are available already, and if reading-writing comes more easily as a consequence, then such children will gain rapid access to the material which will influence I.Q.

(4) With regard to the age at which it is most feasible to start, the group was inclined to think the younger the better; by the time a child is five or six, he may well be absorbed with nonautotelic aspects of his everyday world, with the result that his ability to attain the sort of relaxed and exploratory frame of mind required to enable him to make his <u>own</u> discoveries is impaired.

(5) Observation of convulsive children (those with various forms of epilepsy) suggests that ability may be distributed among them bimodally, with that part of the distribution at the positive end skewed positively and the negative skewed negatively. The occurrence of frequent "subclinical electrical storms," let alone the infrequent

clinically observable seizures, would be naturally expected to impair learning by making the child's experience discontinuous--in the direction of chaos. What the group had not expected was that some of the most startling inductive leaps were made by children with occasional mild "storms". It may be that daily practice in tying one's experiences together in spite of small gaps accounts for the development of appropriate abstraction.

(6) Experience with the deaf indicates that this is probably the severest of the handicaps (short of severe mental retardation) studied, at least as far as the socialization process is concerned. Apparently, the most effective way of helping those so afflicted is to use a responsive environment properly equipped with tactile, vibratory, and other sorts of signalling devices so as to treat reading and writing as the primary sources of communication and graft on speaking as secondary.

* * * * * *

Finally, the group wanted to make some suggestions for improvements of the program which bear centrally on its purposes and interests: for example, to press for some such program as the Initial Teaching Alphabet or "simplified spelling". Or, in the interest of speed of typing, one might complicate the conventions so as to arrive at something like the output of a stenotype machine. Or, if wedded to traditional orthography, one might at least replace the present standard keyboard by more efficient arrangements of the letters; tests have shown that appreciable gains in efficiency can be made by designing the keyboard more rationally.

If the point is not yet clear, let it be known that if efficiency is the goal, the thing to do, as has been learned from countless cases in almost every branch of human endeavor, it is to leave the people alone but change the relevant cultural objects and/or associated equipment. The way to improve the productivity of the man behind the plow is not to give him more training or more exhortation to hard work; the thing to do is to give him a tractor. Efficiency requires a better (cultural or mechanical) mousetrap.

Interest in this project, on the other hand, lies in attempting to understand how the abilities and capacities of human beings can be improved vis-a-vis confidence and ease in a variety of environments, competence in handling cognitive and emotional problems, creativity, and in a host of other directions which are too vague to specify carefully. But this much seems clear: any study of the possibilities for improving human abilities and capacitites requires not only empirical evidence concerning potentialities, but also some theoretical rationale for constructing a yardstick in terms of which one can measure the ways human beings go about handling symbolic material.

Here is an example of extensive structuring aimed at the modification of human behavior. Unfortunately, little replicable research has emerged to date to substantiate the Yale group's enthusiasm for the scheme. More work is in order before this vein of inquiry can be assessed.

Military Training Inquiry

The military is continually confronted with the task of training individuals, drawn from all walks of life, to perform complicated skills. Training usually involves relatively short periods of time under the

guidance of individuals not trained to teach. The task is complicated by demands for consistent, high-level performance by graduates of the programs. These conditions have contributed to a rich tradition of disciplined inquiry aimed at arriving at the most effective methods of developing desired performance in the shortest period of time. Exemplars of this research tradition are cited to illustrate the modus operandi involved. Four overarching themes are developed: one emphasizing methods of instruction; a second stressing the utilization of instructional materials and devices; a third focusing upon follow-up of trainees, and a fourth viewing systems strategies in the military training context.

Methods of Instruction. Maintenance training programs pervade all spheres of the military establishment. And the performance demands inherent in these programs are among the most rigorous known. So, several studies of these programs have been selected for inclusion in this report.

Requirements most appropriate for ordnance electronics maintenance training and methods of analyzing electronics tasks were developed by McKnight and Butler (9). The process included system, task, and knowledges and skills analyses, and determination of training objectives. A representative MOS, Nike Track Radar Repairman, was analyzed by these methods and the results reflected in a 22-week experimental course: more emphasis was placed on practical maintenance procedures and certain technical aspects, and less on circuit operation theory. Graduates of the experimental course surpassed graduates of the 39-week standard course on an overall job-sample measure, and on trouble-shooting the radar system and components. They ranked almost as well as field-experienced repairmen troubleshooting radar components, but somewhat below

them in other areas tested. It was concluded that the kinds of content identified in the Nicord analysis need to be given greater emphasis in current electronics maintenance training.

Several studies over the past decade have shown that proceduralized troubleshooting can produce acceptable or better performance of this complex maintenance task while permitting substantial reduction in the costly training typically associated with its accomplishment. The term 'proceduralized troubleshooting' is usually applied when the decision about where the system the technician is to check next, based on the results of previous checks, is made by a performance aid which directs his actions. This same performance aid, however, can also display expected normal readings and tolerance, test point locations, test equipment and test selection parts identification, and much other necessary and/or useful guidance. Elliott (10) described a methodology following from experiences with and subsequent to development of a fully proceduralized within stage troubleshooting performance system for purposes of experimental evaluation. It is based upon the rationale of maximizing information gain per unit test or operation cost. Examples of troubleshooting procedures developed for use in the evaluation are described in his final report.

In another study Elliott and Joyce (11) focused upon procedural and conventional electronic troubleshooting. Two groups of subjects solved the same set of 13 troubleshooting and repair problems in seven solidstate circuit modules which contained up to five stages each. Both groups used the same hand tools and test equipment. One group was composed of 41 Air Force 5- and 7-level technicians who normally maintain such equipment as part of their jobs. The technicians used the same troubleshooting techniques they ordinarily used on their jobs,

and they were provided with a conventional technical orderlike performance aid to support the task. The other group was composed of 20 high school students with no prior training or experience in electronics. Their training for this study consisted of a special 12-hour course (compared to several months for the technicians) and they used a specially developed performance aid which told them which check to make, based on the outcome of previous checks. In terms of the speed with which they worked or the frequency with which they were able to effect repairs on the modules, there were no substantial differences between the two groups. But the difference in training time and, therefore, cost of training between the two groups is so great as to suggest the possibility that job-relevant training and proceduralization of the task can introduce substantial savings, even after the cost of developing the special performance aids required by proceduralized troubleshooting is subtracted.

A previously developed personnel subsystem reliability prediction technique is extended and a method for estimating the overall effectiveness of task performance is described by Siegel and Michle (12). The effectiveness calculation is based on four factors: performance quality, probability of success on each of the various activities in the task, elapsed time, and manpower requirements. Computational examples, based on electronic maintenance are presented. The technique is held to be useful for quantitative comparison of the effectiveness of different teams or individuals who perform the same task, prediction of the performance effectiveness on a task of a team or an individual, optimization of personnel assignments and operating procedures, and training requirements derivation.

A followup assessment of graduates of selective electronics training

for electronics technicians was conducted by Steinemann and others (13) to evaluate the job capabilities and the shipboard utilization of six-year obligors in the fleet. The sample included graduates who were assigned to the Pacific fleet and located aboard a total of 29 different vessels representing 15 ship types. Assessments involved a variety of evaluation procedures and included shipboard interviews and testing at a shorebased facility. Nicholas H. van Matre and R.J. Harrigan (14) conducted a similar follow-up investigation of the job proficiency of the graduates of an experimental job-oriented training program for electronics technician (X-ET). This program was designed to train lower-aptitude personnel, in a relatively shorter time to assume ET duties in the fleet.

A field experiment was conducted by Folley, Woods and Foley (15) to compare the effectiveness of three modes of instruction in the use of the Af 1807 oscilloscope (Tektronix 545A). Skilled electronic technicians of the U.S. Air Force Security Service served as subjects. One group was trained with an audio-visual instructional program, and a second group with a book form of the same program. The program combined verbal instruction and responses with practice on an oscilloscope. A third group was trained in the manner normally used at the school where the study was conducted. Analysis of variance on test scores indicated superiority of both forms of the program over the conventional instructions with no difference in effectiveness between programs. Electronic aptitude, as measured by the Airman Qualifying Examination, correlated significantly with test scores for the conventionally trained group and for all subjects together.

A prototype classroom training program was developed by Whitmore and others (16) to train observers to recognize 16 jet fighter/attack

aircraft to a criterion performance level of 95% correct recognition at five-second exposures. Previously developed experimental 35mm color slides were used for training. The training method placed emphasis on recognition feature learning, discrimination learning by means of similarity groupings of aircraft and simultaneous paired comparisons, cumulative practice and review, periodic testing, and remedial training. The 95% level was reached during the 16th 50-minute session, an average of one aircraft per session. On a transfer test using degraded images, the class averaged 61%--three times higher than a traditionally trained class in a previous pilot study. Most of this gain, however, may be due to increased training time. There was a substantial correlation between the transfer test and achievement, indicating that the recognition skill acquired during training would transfer to some other image condition.

Scheffler (19) explored the use of students as indexers to improve the operation of a document retrieval system. The availability of students at the University of Dayton had suggested their possible use as indexers for indexing documents for the Aerospace Materials Information Center (AMIC). A student had been employed and informally trained in indexing. The success of that experience, the successful development of a controlled vocabulary, and the need for additional indexers led to the inauguration of a formal indexer training program for upperclassmen. The design, implementation and evaluation of the training program are described. It was concluded that students can become proficient indexers. Modifications were made to improve the various operations of the retrieval system: the AMIC system was transferred from the University's NCR 304 computer to the government's IBM 7094 computer facilities at WPAFB; modifications were made in the

vocabulary and the saurus to make them easier to use and to save professional time; microfilm equipment was installed to increase the efficiency of screening search outputs.

Several research groups focused upon methods of team training in order to better understand its specific dimensions. Karl Egerman (5) studied the effects of team arrangement on team performance. Three groups of six 2-man teams, differing only in arrangement, underwent 2 major phases of training: preteam, where each individual developed a proficiency in making a timing response; and team training, where each S used his timing skill as a team member. Individual preteam proficiencies and the team arrangement were the only 2 variables used to predict (a) initial teams performance, (b) the schedule of reinforcement for each S, and (c) the manner in which team performance would change from the initial to the final periods of training. This investigation points out the feasibility of applying learning-theoretic principles to a study of group behavior.

Briggs and Johnston (6) conducted a four-year program laboratory research on team training in a Combat Information Center context. The research literature on team training is reviewed, and a set of conclusions is drawn with regard to team performance as a function of task, training, and communications variables. In addition, the implications from this research are presented with regard to a specific team training device: the 15F5 device which is used to teach tactical skills in the context of an airborne tactical data center. The appendixes contain full descriptions of three laboratory studies not reported previously in the literature.

Three studies of simulated team environments are described in a report by Short, Cotton, and Klaus (7). Each study dealt in some way

with the transition performance decrement that occurs when individuals are placed in teams. Study 1 found that this decrement was, in a large part, a function of the change in reinforcement ratio that occurred between individual and team training. Study 2 showed that reinforcement in the team environment was a function of characteristics of the team members themselves--their number and the proficiencies. An increase in the number of team members or a decrease in their proficiency produced lower reinforcement ratios and these in turn produced larger decrements in performance and increased the time required for teams to reach high levels of proficiency. Study 3 showed that the transition performance decrement could be reduced by certain training strategies notably those involving a simulation of the team environment during individual training.

Klaus and Glaser (8) summerized the results of research at AIR's, Team Training Laboratory from December, 1960 until August 1967. During this time seven technical reports were issued by the laboratory. This summary report briefly describes each of these seven studies and reviews their purpose and major results. The final section of this report identifies some practical implications of this research and relates the underlying concepts to the broader context of social behavior.

Instructional Materials and Devices. Since individuals who conduct military training programs usually have not been exposed to formal training as teachers, military training program planners have looked to materials and devices as a primary instructional strategy. Hence, the military literature is a rich source of information about the relative merits of various techniques of instruction. A series of representative studies are reported to illustrate this fund of knowledge. Programming, simulation, television, the computer and self-instruction are particular

modes focused upon.

Five studies have been selected to portray work underway with simulation strategies. Angell, Shearer, and Berliner (18) discuss performance evaluation in the training environment, specifically in training situations involving the use of simulators and other complex training equipment. The important variables involved in developing a system of performance evaluation are seen as (1) types of behaviors, (2) types of measures or mensural indices, and (3) types of instruments for recording performance. Factors relating to those variables are discussed, and some of their interrelationships are delineated. Matrices which facilitate the consideration of interrelationships among the three variables are presented. An illustrative application of an automatic training/evaluation system is given.

Another experiment was conducted by Donald E. Meyer and others (19) to determine the effects of simulator training to criterion proficiency upon time required in the aircraft. Data were also collected on proficiency levels attained, self-confidence levels, individual estimates of capability and sources from which that capability was derived. Subjects for the experiment were 48 airline captains transitioning into the DC-8 aircraft. The subjects were equally assigned to experimental and control treatment groups. Subjects in the experimental group were trained in the DC-8 simulator for as much time as required to satisfy their instructors that they could perform the required maneuvers in the simulator at the same level of proficiency required to pass the final qualifications check in the aircraft. The control group was trained using the standard curricula which required a fixed time in the simulator. Data obtained from student reactions to questionnaire items are interpreted to indicate that: (1) simulators can be used to

further reduce requirements for training time in aircraft; and (2) simulators can be used to evaluate performance that is indicative of performance in the aircraft.

Lenier and Butler (20) conducted an experiment to assess the teaching effectiveness of a government furnished ground pilot trainer utilized in instruction designed to develop primary and instrument flight proficiencies. The design of the private pilot study required the selection of three groups of candidates, differential employment of the ground trainer with each of these three groups, and comparison of the measures of training progress and attained proficiency versus a comparison group of pilot candidates taught by the usual methods, i.e. without use of a ground trainer. The instrument rating experiment required the selection of ten pilots, all with minimum IFR experience, to be trained to flight performance required for instrument rating, utilizing the ground trainer combined with flight instruction. Ground trainer instructional hours and aircraft instructional hours required to develop proficiency in primary flight ability and instrument rating ability are reported. An analysis of the data revealed that the ground trainer does not reduce the total number of instructional hours necessary to achieve flight proficiencies but the trainer does reduce the number of aircraft instructional hours ordinarily required in the acquisition of such proficiency. The ground trainer was found to be of most value in developing navigational competence and command ability.

Experimental flight training was conducted in conjunction with a commercial model ground trainer by Phillips (21) to determine its effectiveness in contributing to the proficiency level normally obtained by students undergoing a rigidly controlled flight syllabus without use of synthetic training devices. Differential levels of training

with the ground trainer was prescribed for three experimental groups of students. All students in the experimental groups were permitted to accelerate their individual training with respect to their demonstrated proficiency. Results indicate that no appreciable reduction in total aircraft training time was in evidence, particularly in view of the additional hours of training performed in the ground trainer. However, aircraft time was reduced from 50 hours to 43 hours but at the cost of ground trainer time. A second phase of the experimental program involvinguse of the trainer was the instrument training for a control group of students having Private Pilot qualifications. Additionally, physical features and equipments of the trainer were evaluated and comments are included in the discussion.

The final study on simulation, reported by Crook (22), is an evaluation of the effectiveness of different types of ground trainers when used in the private pilot flight training program. One objective was to determine standards for identifying group trainers in which instruction would be acceptable toward pilot certification requirements. A second objective was to determine how much time in a trainer might be substituted for actual flight time. No specified design or operational standards for ground trainers is recommended. Results showed that average total airplane time to reach private pilot proficiency was reduced by 16%. A 15% substitution of trainer time for airplane instruction time is recommended in the approved 35-hour primary flight curriculum requirements.

Four studies are cited to depict the potential of programming techniques within an instructional setting. A report by Shriver and Trexler (23) describes the Technical Advisory Service rendered to the Navy in connection with the Task FORECAST concept of electronics maintenance. This concept is presented as a collection of policies, methods,

techniques, and services integrated in a plan for improved level of electronics maintenance in the services. Special reference is made to the application of the FORECAST concept to the Navy LORAN system and to the resulting products and level of performance achieved. In implementing FORECAST procedures, Navy chief petty officers, working with FORECAST scientists, produced a technical manual and training program, using an especially designed device and programmed instruction. The same tests in identifying malfunctions in LORAN systems were given to 86 Navy electronics technicians, FORECAST trained, and to 12 graduates of a conventional Navy course. FORECAST students identified 39% of the bad parts; conventionally trained students, 13%.

A project conducted by Fiks (24) demonstrates the feasibility of teaching elementary Vietnamese language skills with a self-instructional program. The performance of the 16 course completers in auditory comprehension and oral-production tests was considered satisfactory (90 and 73%, respectively) and their attitude toward the course was generally favorable. Foreign language aptitude was found to correlate negatively with the time required for completion and positively with auditory comprehension performance. Partial correlation analysis shows FL aptitude to be confounded with a student's age and inadequately defined in terms of learning rate alone. An experimental comparison between protracted aural comprehension training prior to oral production vs. alternation between comprehension and production lessons resulted in no stable group differences either in terms of achievement or attitude. Some differential effects in the time factor were examined.

Johnson (25) used two types of programmed instruction sequences (inquiry and tutorial) on the PLATO system to teach electrical network analysis (EE 322, University of Illinois). Two groups of students were

selected to use each of the two types of instruction. Both of the instruction sequences were to provide the same performance objectives. The report describes the design and use of the instruction on the PLATO teaching system and summarizes the performance of the students with respect to the two methods of teaching. The study indicated that the desired performance objectives were obtained satisfactorily in both cases. Although in certain aspects the inquiry teaching program exhibited some advantages, a teaching program which could make available all of the facilities contained in the present programs would be more desirable.

The checks and procedures necessary to determine whether the major functions of the Nike Hercules fire control system could be satisfactorily accomplished were chosen by Haverland (26), and programmed instructional materials were written to teach junior officers the relevant technical information. Evaluation of these materials indicated (1) that they taught a substantial amount of technical information additional to that taught in the Officer Basic Course (44-A-C20) at the U.S. Army Air Defense School, and (2) that more technical information was learned from the SAMOFF IV programed instruction than was learned from directed study of existing Army reference material.

Both the computer and television seem to contribute meaningfully to the classroom setting as well. The purpose of a study by Engelbart and Sorensen (27) was to explore the feasibility of using a computer to teach a psychomotor task, i.e., operation of a 5-key chord keyset for binary coding. The other functions studied were mode of presenting prompts (visual, tactual) and effects of feedback upon performance. The automated visual and tactual prompting modes were compared with what might be considered to be a 'traditional' mode, in which subjects

(Ss) learned the code by referring to a code sheet. The results indicated that none of the methods of prompting was superior to the others. However, the fact that Ss could be taught to perform a psychomotor task by means of a computer is a significant advance in training procedures. The results also indicated that the provision of feedback aided performance for each of the prompting modes. Rock and others (28) offered a report concerned with the evaluation of television as a medium for rapid, mass training. The principal findings of an experimental comparison of television training are presented along with other forms of training for Naval Air Reservists. Some groups of Naval Air Reservists were taught by television broadcasts. Comparable groups were shown film recordings of these broadcasts or were taught in the conventional manner by instructors who gave lectures and used only standard training aids. All of the trainees were tested, and the results of these test were compared and analyzed statistically to find the relative effectiveness of the three training methods used. The experimental program shows that television is an excellent training medium and that it can easily be made better than good classroom instruction.

How to train individuals for heterocultural interactions is an important unsolved problem. A plan was formulated by Stolurow and Sonthai (1) for the preparation of self-instructional materials toward the end of developing a sound training procedure that permitted the objective study of its effectiveness. The primary objective of these materials is to develop sensitivity to cultural differences: the materials must teach individuals from interpersonal interaction differences to discriminate between their own culture and that of others. The specific discriminations are less important with this purpose

than the ability to recognize that a cultural difference exists. Critical incidents of heterocultural interactions represent an important 'raw material' for the development of self-instructional materials. They are examples of situations which led the reporter of the incident to a change in attitude toward a member of another culture. Consequently, this type of critical incident has the requisite information for teaching discriminations of the type that conceivably could transfer to the learner's own future experiences. The critical incidents were collected by different agencies and come from a variety of respondents. They are the 'raw materials' for the development of the episodes used in the self-instructional programs called culture assimilators.

This study motivated a series of subsequent inquiries. Fiedler and Triandis (2) sought to identify culturally critical concepts and behaviors which are likely to affect interpersonal relations and task performance in culturally heterogeneous groups. Subproject I (Triandis) developed several techniques for identifying cultural differences in interpersonal behaviors. These include the Role Differential and the Behavioral Differential by Triandis, and Semantic Feature Analysis by Osgood. The three techniques measure the ways individuals from different cultures perceive and interpret interpersonal behaviors. Subproject II developed a self-instructional training system called the Culture Assimilator. Culture Assimilator programs are available for Iran (Chemers and Chemers); Thailand (Foa and Mitchell); and Honduras (Symonds, O'Brien, Vidmar, and Hornik). Subproject III (Fiedler) continued work on a theory of leadership effectiveness (The Contingency Model) which now enables the prediction of group and organizational performance with relatively high consistency. Particular attention has been focused on extending the Model to groups with culturally

heterogeneous membership and to groups and organizations with coacting and counteracting (negotiation and bargaining) tasks. A number of methodological studies were conducted to identify some of the task-related factors which influence performance.

The Culture Assimilator technique was also studied by a group situated at the University of Washington. Stephen Worchel and Terence R. Mitchell (3) offered American military and civilian advisors in Thailand and Greece training in the form of either the Thai or Greek Culture Assimilator. These groups were compared to similar groups of men who received a series of essays (Thailand) or no training at all (Greece). Background information as well as information on the subject's impression of his performance and adjustment in the foreign country was collected. The questions on this latter questionnaire constituted the main dependent measure. Assimilator-trained individuals felt that they were generally more productive and had somewhat better interpersonal relations with the Thais than did essay-trained subjects. The Assimilator was also seen as somewhat more interesting and helpful than was the essay. These results were replicated for Assimilator-trained subjects in Greece when their ratings were compared to subjects who received no training. These results were taken as an indication that the Culture Assimilator could serve a valuable function as a culture training device for Americans stationed abroad.

An overview of the culture assimilator technique, based upon self-administered programmed culture training manuals, was reported by Fiedler, Mitchell, and Triandis (4) in 1970. They concluded the technique was an apparently effective method for assisting members of one culture to interact and adjust successfully with members of another culture. Culture assimilators have been constructed for the

Arab countries, Iran, Thailand, Central America, and Greece. The paper describes the steps involved in the development of these programs, as well as briefly reviewing studies validating the culture assimilator programs under laboratory and field conditions.

How does one decide upon the efficacy of specific training devices when planning instructional experiences? Two reports provide a perspective for making such decisions. The Special Devices Center (29) constructed a form to provide a quick method for determining how effective a training aid or device is and whether the device should be modified, used differently, or abandoned. The more effective a device, the more it helps the teacher to teach and the student to learn. This form was tested in a wide variety of training situations with many different devices and was found to be a useful method for determining the effectiveness of a training aid or device. It can be used for such training devices as mock-ups, cutaways, modified operational equipment and complex trainers. It does notapply to films, slides, projectors, charts, blackboards or training aids similar to these.

Criteria for evaluation of training device effectiveness were also developed by Dunlap and Associates (30). They examine methods of evaluation with particular emphasis on the problems of objective evaluation in the on-going training situation. Consideration is given to problems of measurement, experimental design, and analysis in the field setting. Further, attention is given to the issues of utilization and design of training devices and their influence on training effectiveness. An evaluation of the Aetna Drivotrainer was made and consequent recommendations are included for the 11H54 Driving Improvement Trainer. A criterion-referenced measurement system was developed for the 1BZ2 Maneuvering Tactics Trainer for possible subsequent use

in evaluating that device.

Follow-up. Three studies are cited to illustrate concerns about training and skill loss. The first, reported by Rose and Turner (31), represents the initial phase of research in the design and development of techniques to reduce loss of technical skills due to sustained non-practice of the skills. The greatest incidence of skill loss in the Navy is presently considered to occur when personnel are assigned to non-rating related billets ashore. This report is primarily a bibliographic survey of research previously or currently conducted by the Navy and other military services. Conclusions drawn from this survey are (1) Most of this research concerns operating rather than maintenance skills and has to do with perfecting initial training methods that will prolong job skill retention, (2) Specific research in progress is mainly oriented toward the long-term memory of motor skills or complex, interacting team skills on integrated systems, and (3) There is a conspicuous lack of research related to the loss of skills due to non-practice in those skills. The report recommends that subsequent research be directed toward (1) identifying ratings and skills levels of ratings in which loss presently occurs, (2) determining the extent of skill loss encountered, and (3) determining in each instance specific courses of action designed to enhance rating skill retention.

The phenomenon of rapid technological change has not only been said to pose a threat to unskilled and skilled workers, but it reportedly results in fears about job security among engineers, who paradoxically are often the initiators of technological change. This problem is usually couched in terms of obsolescence of technical knowledge and skills and it is generally attributed to the information explosion. In a study of 39 firms in various industries reported by Kaufman (32), all but four

indicated that obsolescence was a problem among their technical staff members, with the problem being major or sizeable in 27 of the organizations (Norgren, 1966). From this evidence, it may be observed that both engineers and their managers perceive obsolescence to be a significant problem which is likely to be serious in the not too distant future.

Measurement of training outcomes as a requirement for evaluating new training techniques is one that is difficult to meet. Managers may have different concepts of what they want, than do the investigators. Bond and Rigney (33) report possibilities for measuring outcomes of training, viewing training as a form of planned social change. Approaches which are discussed include adaptive control models, decision theory models, and simulation models. Illustrations from the CAI literature of recent attempts to measure training outcomes are given.

Systems Approaches. Systems approaches to instruction and human performance are also discussed at length in the available literature. Scholars are continually seeking new ways of putting pieces together in the hope that a better understanding of the teaching/learning phenomenon can be obtained. Five research reports, which reflect this literature, are described.

An AIR report (34) briefly describes technical progress during the first year of a five year project to develop and verify a taxonomic system for the classification of human task performance. During this initial year, the major efforts on the project proceeded along four lines of activity: (1) review of previous taxonomic efforts, (2) development of an integrative model, (3) development of provisional classification schemes, and (4) development of a human performance data base. Previous taxonomic efforts were reviewed to provide guidelines and suggest approaches for the development of classification systems.

An integrative model was developed to indicate which areas had to be taken into account in the development of a comprehensive task taxonomy. A provisional classification scheme, based on human abilities identified in earlier correlational studies, was developed to indicate the feasibility of using such an approach and to isolate some of the practical problems that might be encountered in the development of a taxonomy. Work on another provisional classification scheme, based on observable characteristics of tasks, has been initiated. The requirements of a human performance data base were defined to provide a resource and a research tool for testing provisional classification systems being developed.

Smode, Hall, and Meyer (35) offer a critical review and interpretation of the considerable amount of research data that have either direct or indirect implications for the training of pilots. The purpose is to organize systematically the research findings from the human performance and the training research literature that are pertinent to pilot training, and, based on the status of research in defined areas, to identify researchable issues. Successive portions of the report deal with studies on the measurement, simulation, and transfer of training operational components of the pilot's job, and the maintenance of flying proficiency. In addition, attention is given to studies concerned with improving training systems, and recent innovations in training methods are reviewed.

A systems approach to development of teacher training programs is described, and the utilization of the systems approach in the design of teacher education programs is discussed in a report by Lange (36). Particular attention is given to the importance of the systems approach in providing training programs that are relevant to the teacher's

roles. Long-term and short-term future trends are discussed in reference to work on job models for the teacher. Considerations of curriculum design which provide practice integrated with theory from behavioral science and subject matter content are presented. Examples of research and development on teacher training and related training problems are briefly described to suggest current and future trends and to provide illustrations of some of the concepts noted.

A report by Smith (37), based on an extensive survey of current literature, describes and discusses a system approach to designing training and considers factors bearing on training effectiveness. An efficient instructional system is conceived as one in which the components form an integrated whole, achieving maximum effectiveness at the least possible cost. Components considered in this report include presentation media, student management, techniques for practicing knowledge and performance, knowledge of results, directing student activities toward the goals of the training program, and testing and evaluating the system in terms of efficiency and cost.

Finally, a report by Chenzoff and Folley (38) represents a textbook for instruction in three phases of Training Situation Analysis (TSA), a standardized procedure, developed by NTDC, for systematically gathering and interpreting the information which is relevant to the planning of training and training devices. Three phases of TSA are described in detail: System Familiarization, Task Analysis Method (TAM) and Training Analysis Procedure (TAP). System Familiarization provides an orientation to the training problem, the system structure and flow, and the equipment. Task Analysis Method produces a set of task descriptions containing the information necessary for making training device decisions. Training Analysis Procedure produces a ranking

of tasks based upon the potential benefit to systemperformance as a result of training and the cost of that training. Recommendations for the conduct of these three phases and suggested working forms are presented.

* * * * * * * * *

A continuing theme emerges from these (and many other similar) studies. When performance outcomes are specified, and when short-term training experiences are related to these outcomes, significant behavioral modification can be anticipated. And this success occurs in the absence of a cadre of individuals specifically trained as teachers. Considerable emphasis has been placed upon a variety of instructional devices within the training experiences, and this strategy seems to be more than justified by the evidence presented. People learn well without instruction from professionally trained staff.

Even when a training program appears to be successful, researchers continually focus upon specific dimensions of it apt to be improved. Extensive cost/benefit and time expenditure inquiry is apparent throughout the literature. A pragmatic philosophy of improvement is certainly in effect.

Consequently, behavioral modification is often controlled, is often predictable, and is often efficiently realized. Little is left to chance in these undertakings, and that seems to be an overarching message to be received from this sub-section.

CHANGE STRATEGIES UNRELATED TO SPECIFIC TRAINING

Imagine yourself enjoying a summer vacation at an isolated mountain resort in upstate New Hampshire. You and about one hundred guests at the resort have just been introduced to a brand new rock-and-roll style dance by the Social Director. The dance -- let's call it the "Burp" -- was developed by the Director in association with several friends and resort employees. After the first evening, most guests understood the "Burp"; practically all were "Burp" enthusiasts within three or four days. Two months after the "Burp's" introduction, people throughout the New England and Middle Atlantic states were undulating and contorting in its name. Before the following Winter season passed, the "Burp" was being enjoyed coast to coast. And by late Spring, the dance was being frequently performed in London, Paris, and Rome bistros.

Now, why did the "Burp" capture the fancy of so many people so quickly? Since this is a hypothetical situation (but not out of line--remember Chubby Checker and the Twist), we can make appropriate inferences about the phenomenon that transpired. A product, in this case an appealing dance, was introduced to a captive audience by the dance innovator. The product was enjoyable, free, easily learned, and readily transported. Hence, the target audience adopted it, used it at the resort, and presumably used it upon returning home. Three means of diffusion were thus initiated: first, the Social Director and his friends made the dance a regular part of their social repertoire

and they performed the dance in the Northern New Hampshire environ; second, guests at the resort diffused the dance to their respective home communities and in effect created a snow-ball situation; and third, in all probability the Social Director was called upon to teach and to display the "Burp" in new settings (i.e., metropolitan night clubs, television shows, etc.) Each means described is informal in the sense that little, if any, effort was made to follow-up progress made by recipients of dance instruction. Yet, the dance profoundly influenced the behavior of people who enjoy performing and watching rock-and-roll dancing.

To recapitulate, a new product was offered to a captive audience by its creator. Since the product was easily utilized and proved to be extremely marketable, the captive audience bought it. Their acceptance was the initial step in an uncharted series of events which served to diffuse the innovation to appropriate, but unspecified, target audiences. And, its international popularity served as a measure of the degree to which knowledge of the dance was utilized. Several roles stand out in this process, namely, an innovator--demonstrator, performers, and interested consumers. Here is an account of knowledge which has been successfully diffused and utilized. A model can be extracted from this account which is not at all complicated, but which might prove to be generalizable to other circumstances. Dance innovators, raconteurs, and innovative physical educators, for example, might profit from a knowledge of this simplistic model.

Unfortunately, most innovations worthy of wide-spread utilization demand diffusion strategies far more complex than those employed when popularizing the "Burp". Technical knowledge often is essential, and

this calls for specialized personnel. Imagine the structure of models that represent the diffusion and utilization of the Salk polio vaccine, of hybrid corn, or of a specialized missle defense system. In each instance, knowledge of the innovation is essential for specialized personnel who intend to deal with it.

Researchers are just beginning to engage in systematic inquiry of the process described above. There are surprisingly few studies of the diffusion of innovation in the sense of tracing the movement of: 1) a given new practice; 2) over time; 3) through specific channels of communication; 4) within a social structure. This is all the more remarkable given that one would be hard put even to define various fields of behavioral research without reference to the process of diffusion. Marketing, for example, obviously, has to do with the diffusion of products; anthropology has to do with the transmission and change of culture; sociology is concerned, among other things, with the consequences of technical change, or with the spread of fads and fashions. Yet, these additions have tended to ignore the itinerary of change in the sense in which the diffusion process is defined above.

The aim of what follows is to compare two studies which have made a start in this direction. The one, by Bryce Ryan and Neal Gross (90) is a study of how hybrid seed corn gained acceptance among farmers in two Iowa communities; the other by James Coleman, Elihu Katz, and Herbert Menzel, (92) is a study of how doctors in four communities responded to the availability of a new "miracle" drug. Despite the seeming difference between a new seed and a new drug, and between farmers and doctors, the two studies are comparable at many points, with respect both to research design and research results.

These studies also represent a noteworthy convergence of two traditions of social research which have had virtually no contact with each other. The hybrid-corn study is one of the earliest products of that branch of rural sociology which has concerned itself--for the last fifteen or so years--with the study of factors affecting the acceptance of new practices recommended to farmers for adoption. The drug study stems, ultimately, from the tradition of research into the effects of mass communication. The two traditions have in common a concern with what has been called "campaigns"--attempts, in the short run, to change opinions, attitudes, and actions. In this sense, a voting campaign, or a campaign to reduce prejudice, or a marketing campaign are similar to the campaign of an agricultural experiment agency to persuade farmers to adopt some innovation. Yet, despite this similarity, the two traditions have shown little interest in each other. The key to the vast gap which has separated them is, surely, the different images of society which they have held. Mass communications research has tended to envision society as an audience of isolated individuals, hooked-up to the mass media but not to each other. Indeed, the mass media are the very symbols of the atomized mass society. Rural sociology, on the other hand, conceives itself as being located near the opposite end of the "Gemeinschaft-Gesellschaft" continuum.

Very recently, however, mass communications research has begun to revise its image of the audience. A series of studies in the last few years has revealed not only that modern, urban society is not as individuated as had once been assumed but that the connections among family members, colleagues, and the like, have an important share in the communications process. It is this concern with interpersonal processes which is beginning to forge a link between the two traditions

of communications research being considered. Nevertheless, the drug study was completed without any real awareness of its many similarities to the study which had been undertaken by Ryan and Gross almost fifteen years before.

Altogether, considering that farmers and corn seed were compared with physicians and drugs, the similarities in the findings of the two studies give strong support to a number of empirical generalizations.

The comparability of the two studies is made possible in the first place because both studies were designed to take account of the major components of the process of diffusion viewed sociologically. Thus, 1) both studies focus on a given innovation. 2) Both follow the spread of the innovation through time, by devising methods for assigning a date to each adopter's first use of the innovation. 3) Both studies are concerned with the channels of communication which carried news of the innovation as well as with the channels which carried word that it was all right to go ahead and try. And, finally, 4) both studies specify social structures within whose boundaries the innovation spreads and with respect to which individual adopters are differently "located".

Given this kind of research design, certain kinds of analysis follow directly. Thus, both studies plot curves of diffusion to map the spread of the innovation, over time, within the social structure or various parts of it. The authors of the corn study inferred from the curve that interpersonal influence would appear to account for the observed pattern of spread. The drug study went one step further and, by comparing the curves for "integrated" and "isolated" doctors, could show that interpersonal influence was operative precisely where it would most likely be expected--among the "integrated" doctors. Thus, the drug study was able to confirm and further to specify the conditions for the

operation of interpersonal influence in the process of diffusion.

Similarly, employing the data on channels of communication, both studies find that "information is not enough"--neither farmers nor doctors accepted the innovation upon first hearing. It was shown that there are media which typically inform a potential adopter about an innovation and that there are media which "activate" or "legitimate" the decision to adopt. The former tend to be more commercial and more formal; the latter more professional and more informal. The salesman is a key source of information in both studies; interpersonal influence among colleagues is a key source of legitimation. By cross-tabulating time-of-adoption and channels of communication, both studies find the innovators more closely connected to sources of information and influence outside the community. Innovating doctors make more trips to out-of-town meetings than do later adopters; innovating farmers make more trips to the city.

By cross-tabulating time-of-adoption and relative integration, the drug study finds that early adopters have relatively more contacts inside, as well as outside, their home communities; they are more integrated in informal social relations with colleagues. The corn study, however, finds the early adopters more "independent" of informal community ties. Two approaches to the reconciliation of the conflicting findings were proposed.

Whether these generalizations apply equally to the diffusion of other innovations remains to be seen, of course. Surely, the special characteristics of these innovations, the particular way in which they were marketed, the peculiar characterisitcs of the social structures into which they gained entry, must all have affected their social itineraries. Clearly, what is needed is a comparative study of in-

novation which will trace different innovations, variously classified, as they proceed through given social structures.

These two studies were early attempts to account for ways in which behavior is modified. In each case, specific training is incidental to the modification (or adoption) desired. The studies illustrate viable alternatives to specific training strategies for modifying behavior. Subsequent researchers have probed into variables related to these alternatives in order to identify the particularly crucial ones. Most of the work reported in the following paragraphs reflects the social interaction model mentioned in the orientation.

Using the Ryan and Gross study as a basis, rural sociology generated studies involving research into the individual adoption process, information sources and media as change agents, the roles of special functionaries in the diffusion process, and inquiries into the social factors in diffusion, the cultural factors in diffusion, and the situational factors in diffusion. While these studies are too numerous to list in detail, a brief overview will be offered to convey the flavor of the available literature.

The Individual Adoption Process. The rural sociologists have developed various models to identify the levels of adoption by individuals. Lionberger (92) lists these stages as (1) awareness, (2) interest, (3) evaluation, (4) trial, and (5) adoption. This model was derived from the work of Ryan and Gross (90) who found that first use of hybrid seed corn followed a bell-shaped curve when plotted over time. Wilkening (93) in a study dealing with sources of information, hypothesized four stages lableled as (1) initial knowledge, (2) acceptance of the practice as a good idea, (3) acceptance on a trial basis and (4) adoption of practice on own farm. Further work in this area (Beal and Rogers, (94)

found that most farmers were aware of stages as they moved from awareness to adoption, but other studies (Hassinger, 95) have been critical of the adoption stage model on the grounds that the first level awareness is too passive a term to describe the individual's initial steps toward innovation, and that the stages are too distinct to imply that they are universally followed in the individual adoption process. Nevertheless, rural sociologists commonly hold with the five stage adoption process described by the Sub-committee for the Study of Diffusion Farm Practices (96).

Numerous studies have evolved to determine the individual and social factors (including the sources and kinds of information used by the adopter at the various levels), which operate at each of the four stages in the adoption process. Such sources can be generally divided into either personal or impersonal, cosmopolite or localite, types of communication (Rogers, 97). Numerous studies in this area have supported the contention that impersonal information sources are most important at the awareness stage (Beal and Bohlen 98), (Copp, Sill, and Brown, 99) and that personal sources are most important at the awareness stage (Katz, 100), and localite information sources are most important at the evaluation stage (Beal and Rogers, 94), Leary (84) has charted the most influential information sources by stages as follows:

Most Influential Information Source by Stage

Awareness	Mass Media
Interest	Mass Media and other farmers
Evaluation	Well regarded farmers
Trial	Salesmen
Adoption	Peers

In a study typical of those which lead to conclusions about sources of information in regard to the five stage adoption process (Beal and Rogers, 94), 148 farm housewives were interviewed in a mid-western community regarding their sources of information for certain types of fabrics. The researchers found that data supported previous hypotheses regarding information sources in the five stage adoption process, and that most adopters recognized the stages in their own adoption process. Cosmopolite sources were found to be most important at the awareness stage and locality sources most important at the evaluation stage.

In conclusion, the rural sociologists have developed a five stage model to describe the process of adoption of innovations in regard to the individual. Research has supported such a model and has further described the types of information sources critical to each stage.

The Community Adoption Process. Rural sociologists, beginning with Ryan and Gross (90) have found that not everybody adopts new ideas or practices in the same amount of time. Studies in rural sociology using adoption patterns of hybrid seed corn as compared to the time of initial information of the farmer concerning hybrid seed corn (Ryan, 101), as well as other studies using improved farm practices (Wilkening, 93), have proven the existence of a growth curve in regard to the adoption of any given innovation. Studies in education by Cocking (102), Mort and Cornell (103) and Ross (104) have supported this theory. Ross' study, which gained fame from the statistic that it took on the average of fifty years from recognition for a need for change to the time something was done about it, and another fifty years to get a new practice adopted, also found that three per cent adoption often took 15 years, while the next three per cent was obtained in about one fifth the time.

Further research has investigated the rate of adoption in regard to the particular innovation itself and the circumstances accompanying the innovation. The rural sociologists have developed a system which differentiates among people who adopt innovations. Lionberger (92) classes adopters into early adopters, late adopters, and majority, while Rogers uses a slightly more sophisticated scale, rating individual adopters as innovators, early adopters, early majority, late majority, laggards.

Rogers (105) laments the lack of standardization of terms in regard to degrees of innovativeness, listing eight synonyms for innovators, including advance scouts, lighthouses, and cultural avant garde; six synonyms for the term early adopters; four synonyms for the term early majority; eight synonyms for the term late majority; and seven synonyms for what he calls laggards. His point, that such a lack of standardization causes confusion seems well taken, since imprecise definition of what the adopter categories are makes cross-discipline exchange of reseach findings most difficult.

For the purpose of this review of research, adopter categories will be differentiated into "innovators" and "laggards". Such categories conform roughly to Lionberger's "early majority" and "late majority laggards".

Personal Characteristics of Innovators. Numerous studies have been made by rural sociologists in regard to the personal characteristics of adopters. Rogers and Lionberger summarize the research done in this area into the categories of age, social status, financial position, specialization, and mental ability. The research reviewed here will be that which deals with the age of innovators.

Ryan and Gross (90) found great differences in age between the

earliest and latest adopters of hybrid seed corn, both at the time of adoption (20.8 years) and at the time of the research interview (10.8 years). This distinction between age at time of adoption and at time of interview would seem to be a vital one, and is seldom mentioned in subsequent studies of the question.

While Ryan and Gross claimed to have positive proof that early adopters are younger than late adopters, later research seldom makes such definite claims. Typical of such research is that done by Copp (106) which investigated the practices of one hundred and fifty seven Kansas cattlemen, rating them according to adoption scores and then inquiring as to the social and economic backgrounds of each farmer. Copp found that the degree of relationship between age and adoption score was not significant, and concluded that the young farmer was in a generally weak position to adopt better farm methods, probably due to a lack of capital.

Lowry and Hay (107) in a study of health care services and enrollment of voluntary health insurance programs in Stokes County, North Carolina interviewed 280 household heads who represented 1,1081 individuals. They found a positive relationship between increasing age and increasing use of medical services. While this statistic is not particularly surprising, it is interesting to note that the researchers found an inverse relationship between increasing age and use of dental services. The study is pertinent in that it points out the difficulty in attempting to isolate the factor of age from other pressures in the adoption of new practices.

Lionberger and Coughneour (108) studied a farm community in Northeast Missouri and investigated the age of the farm operator as a factor in adoption. The researchers note that while in our society age tends

to be less of an ascribed status characteristic than in other societies, they found strong trends among farmers to look upon older members of the group as wise through experience, and to seek them out as sources of ideas. The researchers found that middle-aged farm operators were sought after the most for information, with the youngest and oldest farm operators following in popularity in that order. However, using improved practice ratings of farmers as the measure, the researchers found that young farmers were most competent technologically, even though they weren't the most sought after for information. The findings of this study tend to demonstrate that young farmers are more innovative than older farmers, but suffer a lack of status among their peers due to their age.

Beal and Rogers (94), investigating the adoption of a spray for weed control and an antibiotic feed supplement, looked at several personal characterisitcs, including age, of those farmers involved in their study in a central Iowa community. Their research discovered that among the 148 farmers interviewed, the earlier adopters of both innovations were older in age than were the later adopters. In relation to the five stage adoption scale, they found that farmers ranked as follows:

Age of Adopters of Weed Spray and Anti-biotics

	Innovators	Early Adopters	Early Majority	Late Majority	Laggards
Weed Spray	53.6	47.7	45.6	40.8	39.7
Antibiotics	53.0	50.4	42.1	40.9	39.4

The results of this study would seem to contradict those of the Ryan and Gross study and the Beal and Rogers study.

There is obvious disagreement among researchers regarding the

significance of the factor of age in regard to innovative behavior. It seems obvious that much of the confusion is due to the inability of the researchers to isolate the factor of age from other factors which influence innovative behavior such as education, size of operation, and wealth. Few studies attempt to differentiate between age at time of adoption and age at time of interview, although it is well known that the adoption process of an innovation from awareness through interest, evaluation, trial and adoption varies according to the individual and the innovation, and would thus affect significantly the factor of age (Beal and Rogers, 94). However, Rogers (105) claims adequate theoretical grounds for innovators being younger than laggards, including the fact that the socialization of personality occurs mainly in early life, and that therefore young people learn more modern, cultural values than do older people. Other research has demonstrated that younger farmers have more social contacts, use more sources of information, and travel more than older farmers, all of which would indicate a greater contact with new ideas, and thus a greater degree of innovativeness.

Information Sources in Regard to Adopter Categories. Rogers categorizes information sources as follows: personal vs. impersonal; cosmopolite vs. localite; close contact sources; numbers of different sources. Lionberger differentiates among sources as follows: mass media; agricultural agencies; and commercial sources, including local dealers and salesmen. Numerous studies have been undertaken investigating the impact of these sources in regard to the five stage adoption process and the five stage adoption scale. Several representative studies of this type of rural sociological work will be examined here in the light of information pertinent to this study.

Research in rural sociology has shown that information sources vary

on the basis of adoption categories. Marsh and Coleman (109), in a 1955 study of 393 farm operators, grouped their subjects into a three category scale: low, medium, and high adoption rates. Through personal interview, they determined that there were differences in the use of type of source according to adopter category as follows:

Source of Information by Type of Neighborhood

Source of Information	Low Adoption (N=156)	High Adoption (N=139)	High Adoption (N=98)
Farm Papers and Magazines	70%	88%	93%
Newspapers	52%	71%	85%
Radio	82%	88%	89%
Farm Meetings	19%	36%	53%
Talking with professional agricultural advisors	34%	66%	82%
Farm Bulletins	28%	50%	69%
County Agent Letters	63%	84%	86%
Dealers and Salesmen	27%	29%	49%
Friends, Neighbors, Relatives	88%	82%	97%

It would appear that farmers in the high adoption category reported more extensive contact with and use of sources, particularly as regards those sources that take some extra effort to come into contact with. Thus, while all three adopter categories use the radio as a source of information to a high degree, when it comes to going to farm meetings, 53% of those in the high adoption category rate such meetings as a source of information, whereas only 19% of those in the low adoption category use such meetings as information sources.

Fliegal (110) in a study to determine the significance of the

relation between adoption rate and sources of information, used data gathered by Wilkening in respect to 170 farm owner-operators with children of high school age living at home. Information was available on the use or non use of certain farm practices (both methods and materials) as well as on sources of information, formal and informal social participation, and other variables.

Data were used to construct indexes of a range of variables hypothesized to have an effect on the adoption of new farm practices. Variables included status and role of operator, size of farming operation, authority to make decisions on farm matters, familiarism, sources of information on farm matters, level of living, and attitude toward new farm practices.

Fliegal found that size of operation and authority were not significantly related to adoption. He did find significant relationships between adoption and sources for information, and found that sources for information accounted for a significant proportion of variation in adoption when other independent variables were taken into consideration.

Copp, Sill and Brown (99) found that while they could not determine the key information source for any stage of the adoption process, they could determine that sources of information external to the adopters social system are more important than local courses for early adopters, and that farmers who relied upon neighbors and friends for information had lower adoption rates than farmers who did not cite such peer influences. This study involved 175 dairy farmers in a western Pennsylvania county each of whom was asked to relate his experience with three recommended dairy practices, and each of whom was then asked questions regarding the information source exposure for the three practices. The farm operators were then classed according to the stage

of the adoption process they had achieved, and the data obtained on information sources was listed according to stage. The researchers specifically mention the difficulty in categorizing information sources, and relate the arbitrarily chose magazines, radio, printed extension circulars and bulletins, oral extension (office calls, meetings, visits) peer influence, commercial media, classroom, and a general category of "other". Such categories, upon extensive review of the research in this field, seem representative.

Beal and Rogers (94) in their study of weed control and antibiotic feed use support Copp, Sill, and Brown in concluding that information sources vary on the basis of adopter categories, and that later adopters depend more on personal sources of information than do early adopters. Beal and Rogers categorized information sources on two basis: mass media, agricultural agency, informal and commercial; and personal and impersonal. They then investigated each adopter category in regard to source. They found that:

1. Impersonal sources (bulletins, research publications) are most important to innovators and early adopters in the early stages of the adoption process.

2. Informal sources are more important for later adopters at the early stages of the adoption process.

3. There is more dependence on personal sources by later adopters than by earlier adopters.

These further studies by Beal using the five stage adoption process framework in regard to new types of fibres and new types of insecticides support the previous work of Beal and of Rogers in this area.

Copp (106) learned that while farmers who failed to adopt recommended practices had full accessability to technical farm information, none exploited available media for farm information to the degree that farmers who adopted farm practices exploited media. Farmers who adopted

recommended practices were those who used information media requiring more effort in reception, such as bulletins, the county agent, and college events. This would tend to support the findings of Copp, Sill and Brown regarding cosmopoliteness of innovators, as well as of Marsh and Coleman, and to support the theories of Beal and Rogers in regard to the use of information sources by innovators and laggards.

Copp also found that the more the farmer relied on technical information sources, rather than local or mass media, the higher the adoption score, and that the same farmers admitted to the influence of a greater number of information sources.

Other research supports the theory that sources of information external to the adopters social system, called cosmopolite sources, are more important than local sources for early adopters. Copp (106) claims that the tendency to adopt recommended farm practices increases to the extent that the operators reference group ceases to be local neighbors and becomes one of technical and professional specialists. Wilkening (93) in a study of 107 North Carolina farm operators found that the fourteen who were classified as innovators had many more contacts outside the community, read many more magazines and farm bulletins from the state agricultural college, and almost always gave agricultural agencies or other extra-community sources for information about improved farm practices. Rogers and Leuthold (111) and Rogers and Burdge (97) give further support to this theory.

Other studies have shown that early acceptors have closer contact with sources of innovation. Wilkening (93) showed that those identified in his sample of farmers as innovators had much more contact with the state agricultural agencies than the other farmers. Rogers (112) reported that in a sample of 200 Ohio farmers, 42% of the innovators

had had contact with agricultural scientists during the preceding year, compared to 10% for the other adopter categories. Beal and Bohlen (98) claim that innovators get their ideas directly from colleges or the research worker. Copp, Sill and Brown (99) support these findings, as do Marsh and Coleman.

The rural sociologists, claiming that early adopters tend actively to seek new ideas, while later adopters have a more passive or even negative approach to the new, have also theorized that the aggressiveness of early adopters would result in not only more cosmopolite sources of information, but in greater numbers of sources of information. Rogers (113) found that Ohio innovators, in addition to being more highly educated, earning higher gross incomes and farming larger farms, discovered that they participated more in extension service activities, traveled directly to agricultural scientists to secure information, traveled widely to observe new practices on older farms and were more dependent on extension and research bulletins of information, less dependent on neighbors and relatives.

A study by Copp (106) bears out this theory. Beal and Rogers (94) found that earlier adopter categories read more farm magazines and newspapers, listened to more radio shows, but found that laggards viewed more farm T.V. shows than did innovators. Beal and Bohlen (98) found that innovators subscribed to the most farm magazines, papers, and specialized publications, while non-adopters took the fewest farm papers and magazines and read the fewest farm bulletins. Studies by Fliegal (110), Marsh and Coleman (109) and Cougheneour (114) support the theory that innovators use greater numbers of sources of information than laggards.

Research on Social Relationships in Regard to Adopter Categories

Done by the Rural Sociologists. Paralleling the work done by the rural sociologists on personal characteristics and sources of information of early and late adopters is a series of studies which concerned themselves with the social relationships of early and late adopters. Lionberger (92) has divided the social groups with which a farmer has contact into locality groups (neighborhood and community): family; social cliques and reference groups; and formal groups. If locality groups, family, social cliques and reference groups are classified as local social systems, and formal groups are classified as cosmopolite, then Rogers contention that earlier adopters are more cosmopolite than late adopters is borne out.

Rogers and Beal (115) evidenced conclusive proof that neighborhoods are one of the most important influences in regard to adoption behavior, and that such social systems were more important to late adopters than to early adopters. Wilkening (116), however, found that when labor from outside the family was used in farming, adoption rates were much higher than when there was no influence present on the farm from outside the family. Additionally, a study (Duncan and Kreitlow, 117) found that farmers who lived in neighborhoods that had different kinds of religious and ethnic groups had much higher adoption rates than persons living in homogeneous neighborhoods.

Ryan and Gross (90) found that those farmers who were using hybrid corn traveled more often to urban centers than did the average farmers, a finding later substantiated by Gross and Taves (118) in a re-analysis of the 1943 study. Lionberger and Cougheneour (108) and Rogers and Burdge (97) support these findings.

Lionberger and Cougheneour (108) in a time-sequence study of the social structure and diffusion of farm information investigated the

relationships of a number of status characteristics to technological competence (improved practice) of farm operators. Included for consideration among status characteristics were participation of the farm operator in formal organizations. They found that the correlation coefficient between improved farm practice and formal social participation was extremely high, and they concluded that participation in formal social organizations is more closely associated with improved practice than any other single factor, except income of the farmer. Further, the study demonstrated that participation in organizations oriented to the provision of useful farm information is more highly associated with improved farm practice than participation in all formal organizations.

In addition, Wilkening (93) found that those farmers who are members of formal groups (groups that elect officers, appoint committees and plan programs) show a significant positive correlation to the adoption of new practices, while other studies (Sub-committee, 96), (Beal and Bohlen, 98) have shown that late adopters are not likely to be members of any formal group, other than a church.

Everett Rogers attempted to draw appropriate principles from studies such as those reported above in a book entitled, Managing Change (120). These principles are described as follows:

Principles Related to the Innovation

1. A crisis emphasizes the relative advantage of an innovation and speeds its rate of adoption.

2. The relative advantage of a new idea, as perceived by members of a social system, is related positively to its rate of adoption.

3. The compatibility of a new idea with (1) previous ideas, (2) individuals' values, and (3) receivers' needs, as perceived by members of a social system, is related positively to its rate of adoption.

4. The less complex an innovation appears to a potential adopter, the faster its rate of adoption.

5. The easier it is for individuals to try an innovation on a limited basis (trial), the faster its rate of adoption.

6. The more easily the essence of an innovation can be communicated and the more visible the positive results of the innovation's use, the faster its rate of adoption.

Principles Related to Adopters (either an individual or an organization)

1. An individual's innovativeness varies directly with the norms of his social system's innovativeness. (There is more individual resistance to change in more traditional systems.)

2. Earlier adopters are younger than later adopters.

3. Earlier adopters have higher social status than later adopters.

4. Earlier adopters utilize communication sources and channels about innovations that are in closer contact with the origin of new ideas than later adopters who tend to use those further removed from the origin of new ideas.

5. Earlier adopters are more active information seekers than later adopters.

6. Earlier adopters are more cosmopolite than later adopters.

7. Earlier adopters have more opinion leadership than later adopters.

8. Innovators are perceived as deviants from the norm by other members of their social system.

9. Innovators perceive themselves as deviants from the norms of their social system.

10. Earlier adopters (especially innovators) are wealthier than later adopters.

11. Earlier adopters are less dogmatic (their belief systems are more open) than later adopters.

12. Earlier adopters have more formal education than later adopters.

13. Earlier adopters have greater mental ability to deal with abstractions than later adopters.

14. Individuals more fully embrace innovations and change when they feel they have participated in planning and decision making concerning these ideas.

Principles Related to Communication Channels

1. Mass media communication channels are most important at the knowledge stage, whereas interpersonal channels are most important at the persuasion stage in the innovation-decision process.

2. Interpersonal communication from peers is more important for later adopters than for earlier adopters.

3. Interpersonal communication from peers is more important in uncertain situations (as in deciding to adopt risky new ideas) than in clear-cut situations.

4. Between-system and within-system communication facilitates innovation adoption by creating a more open flow of new ideas.

Principles Related to Social Systems

1. Social system norms related to innovativeness seem to determine, at least in part, the innovativeness of opinion leaders. (For example, in modern systems, the opinion leaders are often innovators, while in traditional systems, they are not.)

2. Diffusion patterns in more modern systems more often flow between heterogeneous sources and receivers; in more traditional systems the diffusion patterns more often flow between homogeneous pairs. (For example, low status sources talk to low status receivers.)

3. More modern systems are characterized by a higher degree of communication integration; that is, the members are more closely related in interpersonal communication channels than they are in more traditional systems.

Principles Related to Change Agents

1. The extent of promotional efforts by change agents is related directly to the rate of adoption of an innovation.

2. Change agents communicate most effectively with clients who are most like them.

Taken together, these principles can be useful to strategists interested in selecting the most efficient strategies for modifying behavior. This perspective is an important one when time and cost must be related to potential accomplishments. Too often expensive training programs are undertaken when alternatives to this option would prove more effective.

A FRAME OF REFERENCE FOR CHANGE

Given the extensive discussion of studies reported, what next steps seem in order to modify behavior? A frame of reference is offered based upon specific training strategies and strategies unrelated to specific training. Each account offers information worthy of implementation now.

Specific Training

Specific training activities within the field of education leave much to be desired. Program content usually is ill-defined, little meaningful effort is made to recruit trainees, trainee performance during the training is hardly studied, trainee performance as a result of the training is generally unclear, and training transfer to practice is rarely considered. No wonder attempts to ascertain the effects of specific educational training wallow in the realm of the innocuous.

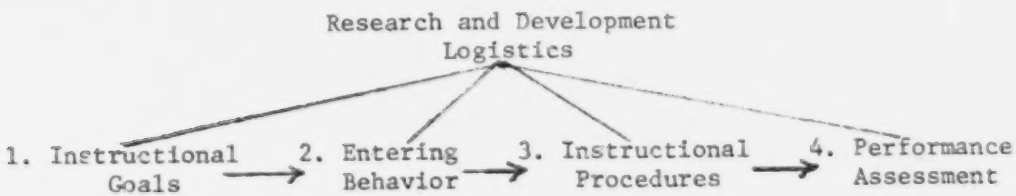
These observations must be credited to the purveyors of the specific training, as it is within their power to continue such sorry activity or modify it in the context of what is known about training. Most are unaware of the rich body of knowledge available pertaining to the modification of behavior. So they employ trial and error tactics destined to be fruitless. Unfortunately, better options are at their fingertips.

One of the most useful discussions of the conditions necessary for

the modification of behavior during specific instruction was written by Robert Glaser in Training Research and Education (45). He offers a general conception with the follcwing components: (a) instructional goals--the system objectives, (b) entering behavior--the system input, (c) instructional procedures--the system operator, and (d) performance assessment--the output monitor. Each of these components is amplified in the following paragraphs.

The development of the system is initiated with the specification of the goals of instruction. These goals constitute the objective to be accomplished and the purpose for which the system is to be designed.

The Component Phases of an Instructional System



The main input into the system, upon which it is designed to operate, consists of the entering behavior of the student. This consists of the initial repertoire, aptitudes, and prior educational background with which the instructional process begins. The next phase constitutes the actual instructional procedures and experiences which are employed to guide and modify behavior. The final phase in an instructional situation is some sort of "quality control," that is, assessment of the extent to which the end-of-course behavior has been achieved by the student in the light of the kind of performance required by the specified instructional goals. These phases are the main flow of the instructional system, but it has many feedback loops and subsidiary inputs. The information obtained in each phase supplies data which are useful for

monitoring and correcting the output of the preceding phase; for example, measurement of the kind of performance achieved can provide information for redesign of instructional procedures, and information on instructional procedures can interact with the characteristics of the entering behavior. Feeding in to all phases are the results of research and development. The implementation of these results and the fruitful interplay between research and development, on the one hand, and the operating aspects of the system, on the other, involve important logistical considerations. With this overview of the instructional system in mind, each of the components will now be considered in more detail.

Instructional Goals and Terminal Repertoire. A first step in the designing of an instructional system is the specification of the purpose and objective to be achieved. In an instructional system, the "end-product" is the behavior of the student. This behavior involves the subject material presented to the student and the responses to this material that he is taught to perform; the instructional process is concerned basically with the subject matter stimuli presented to the learner and with the responses he makes in their presence.

A distinction must be made between instructional goals and terminal behavior. The goals of education are desirably long range and involve complex human behaviors and aspirations. Specification of these goals involves philosophical and ethical considerations for which the educator must share responsibility as a member of society. However, in this paper, discussion is limited to considerations of instructional technology, i.e., the procedures for behavioral modification through systematic instruction when certain objectives are specified (although technique and objectives, the means and the ends, are intimately related). Primary concern is with the methods by which instructional objectives need to

be developed and described in order to assure their attainment in an instructional system, rather than the establishment by the community and the educational society of the nature of educational goals.

In contrast to the broad question of educational goals, "terminal behavior" is defined as the performance that the student should display at the end of a specific instructional situation. There can be minimum levels set for attainment and maximum levels left for individual initiative. When a minimum achievement level is established, it is the task of the instructional system to get most individuals to that point. In military and industrial training, minimum levels are required for the optimal functioning of complex man-machine systems, and the instructional situation must be arranged to accomplish this. In civilian education, minimum levels are required for entrance into a higher and more complex educational level. Within all of this, however, the instructional system does not preclude the "realization of individual talent and potential" and the development and exercise of creativity, inventiveness and artistry. Certainly the instructional situation must be arranged to permit these abilities to grow. Nevertheless, it seems possible that, as a result of systematic study, the terminal behaviors which foster or indicate that this growth is taking place can be identified. Such student performance should be specified, clearly recognized, and actively developed by an appropriate instructional situation. If eventual creativity in a subject matter is an instructional objective, then the terminal behaviors which are related to this comprise the specific behaviors to be elicited in an instructional situation.

Terminal behavior, then, is the end-product objective of a particular instructional situation, and the procedures of instructional technology should result in definable changes in student behavior which approximate

this end-product. In order to be appropriately developed, the responses of the learner should be operationally specified in so far as possible. In the learning laboratory, when the psychologist studies the development and control of behavior, the task to be learned is carefully analyzed and described. Perhaps one of the indications of the lack of interaction between experimental psychology and instructional practice is to be seen in the fact that the educational literature indicates a concern with such terms as "readiness," "understanding," the "whole child," and so forth. Certainly these are important words and need to be analyzed because the behaviors they refer to are amenable to experimental attack and manipulation only when they are behaviorally defined in stimulus and response terms, i.e., specific subject matter situations and observable student performance. This has been a necessity in the work of experimental psychologists in developing laws of learning; increasingly, larger and larger units of behavior such as concept formation and problem solving are being studied and analyzed in such terms. In contrast, there has been a general reticence among educators to submit student responses to analysis in stimulus-response terms.

It is an interesting commentary that when experimental psychologists have turned their attention to training research in the military, they have been concerned with the lack of explicit specification of the behavior under consideration and have attempted to develop techniques of "task analysis" for behaviorally specifying performance objectives. When confronted with this endeavor, the psychologist had to face up to the fact that a definitive terminology for behavioral description was not available nor foreseeably forthcoming from the science of psychology in the immediate future. Much concern has been expressed over this basic lack, and, at present, the development of a taxonomical

scheme for specifying the properties of the task to be learned and the objectives of instruction is an urgent problem.

Initial or Entering Behavior. The behavior brought to the instructional situation is the raw material input from which the end-product will be shaped. These initial behaviors need to be assessed and made explicit so that they can be used as the basis on which to guide student performance. The objective of instruction is to take the student from this initial repertoire to the terminal repertoire. Assessment of entering behavior usually is made with aptitude and achievement tests which are used for student selection, placement, and guidance. Such tests are used as predictors of performance that occurs during or at the end of an established course of study. In most cases, tests are employed to weed out individuals who are likely to be unable to attain the specified terminal behavior under the instructional conditions and time allowed in a particular training establishment. It is also possible to determine the best combination of instructional objectives, entering behavior requirements, and instructional procedures in order to achieve overall organizational goals with maximum utility. These aspects interact so that test selection standards and the time, cost, and characteristics of instruction can be varied to permit optimal functioning of the system. In the military services, for example, the tasks assigned to the various personnel that contribute to the accomplisment of a particular mission may be reorganized so that either more or less rigid selection and training standards are required. This can permit the more intensive training of specialists on particular job aspects while certain portions of their former jobs can be assigned to individuals who have less time available for training. In civilian life, the shortage in certain professions might benefit from such an arrangement. In

education at the high school and college levels, advanced placement programs and the use of college professors in high school courses are further indications of the result of consideration of the interaction between entering behavior and other components of an instructional system. It is not impossible to envision different colleges that require two, three, four, or five years of attendance that all bring their students to a somewhat similar level of terminal behavior. Such schools would require different initial repertoires for their entering classes, as assessed by various tests of achievement and motivation, and they would have different long-range educational goals.

Instructional Procedures. In a particular instructional situation, instruction begins with the student's entering repertoire and ends with the terminal repertoire with which the student leaves the situation. During the interval between these two points, instructional manipulations and learning experiences take place in the course of which the student emits responses which guide him toward the terminal behavior. The behavior elicited from the student by the teacher for this purpose can be called auxiliary behavior. The instructional process is concerned with the utilization of auxiliary behavior in order to approximate the desired educational objectives. This process is facilitated by determining, for various stages of learning, the subject matter stimuli, e.g., words, paragraphs, symbols, formuli, etc., to which the student must respond and the kind of response required to each of these, e.g., solving problems, writing, building something, etc. These activities must be specified in terms of observable behavior so that appropriate feedback can be obtained by the teacher for use in further instruction. While the precise specification of behavior may be limited by an inadequate descriptive taxonomy and by a lack of psychological knowledge

in analyzing complex behaviors, it seems possible to outline to some extent such things as behavior development through reinforcement, readiness, the guidance of learning, transfer, practice, understanding and reasoning, and motivation, in terms which permit instructional control and which also permit research on the instructional guidance of complex behavior. Since the heart of the instructional process is the actual procedures and techniques used in shaping and modifying behavior, and since this is also a main concern of the science of learning, a brief examination of some points of contact between the two is relevant here.

At the start, the point of view should be expressed that the application of current theories of learning will be less fruitful at the present time than the application of current findings. To illustrate, almost all psychologists of learning, regardless of their stand on some form of reinforcement theory, would agree with the empirical statement of the role or reinforcement in the acquisition of behavior. Vigorous disagreement, however, shows up in theoretical interpretations of the empirical findings. Most of the recent work on teaching machines and programmed learning is an example of the application of findings about the effects of reinforcement. The empirical facts have been known for some time but only recently quite seriously applied in the development of instructional devices.

The Guidance of Learning. As has been indicated, guidance during the instructional process is concerned with the way in which student responses are employed in the course of auxiliary behavior leading to terminal behavior. Several notions can be considered here. First, the transfer of stimulus control over a response. At the beginning of a learning sequence, subject matter stimuli are used to evoke responses that are already in the initial repertoire that the student brings to

the teaching situation. Instruction takes place when the student proceeds to perform stimulus-response combinations that are different than these. What happens in the course of auxiliary behavior is the gradual transfer of responses under new stimulus control. The gradual transfer of behavior to new stimuli is what happens, for example, in teaching spelling. The work which the student reads is first shown in its entirety, then the student supplies the missing parts until he can write the whole word in the absence of contextual stimuli and in the presence of spoken or pictorial stimuli. The notion behind this response transfer has general application to educational technology, and the specifics of the process are a matter for investigation.

A second notion is response prompting. When the initial repertoire is specified, the instructional procedure can utilize only these available responses. The instructional task is to get the student to emit small increments in response which move in the direction of the terminal behavior. It is sometimes thought that the successive approximation procedure employed in a Skinner box is a useful paradigm here. The analogy is useful up to a point. In a Skinner box, one often waits for certain behaviors to occur which are in the direction of the terminal behavior and then reinforces these responses. In the classroom it is more efficient to supply a variety of stimulus materials which prompt out appropriate behavior that can then be appropriately reinforced. The use of prompting to enable students to emit new or low strength responses with a minimum of errors appears to be an important consideration in the development of instructional procedures. The occurrence of a response is made probable when the presentation of instructional stimuli is designed so that each learning step makes the correct response in the next step more likely. The probability of such success is increased

by the use of prompting stimuli based upon what is known about the student's initial response repertoire at a point in learning. The characteristics and uses of response prompts and cues are interesting areas for research and analysis.

Related to response prompting is the withdrawal of cues in the course of auxiliary behavior so that the student eventually responds to the form of the stimuli desired in the performance of the terminal repertoire. In the course of an instructional procedure, response prompts are gradually eliminated in so far as required so that the student learns to perform in the presence of minimal or covert cues and in the absence of seeming external prodding. Teaching machine programs refer to this withdrawal process as stimulus fading or vanishing. Research is required in various subject matters on specifics of this process such as the rate, repetitiveness, sequencing, etc.

A third parameter of response guidance in instructional procedures is the form of the response emitted by the student. There has been much pseudo-controversy on this aspect in research on teaching machines. In his early work on self-instructional scoring devices, Pressey employed multiple-choice responses. In his recent work, Skinner has emphasized the role of constructed responses. Psychological experimenters, however, alert for a controversial variable, have rushed to test the effectiveness of these two "points of view". In reality, the basic assumptions of both Pressey and Skinner do not make one kind of responding more correct than the other. It is again a function of where the student is to go, the desired terminal behavior. In the development of instructional procedures, however, the form and encoding of the responses can be an important matter. For example, multiple-choice responding is much easier to evaluate objectively, write-in responses permit more subjective

evaluation, and covert responses leave little data for analysis. However, the mode of response needs to be considered in relation to the task to be learned. Future research must investigate the relationship between particular forms of response and stated educational goals. To be considered in this research is the effectiveness of response modes at various educational levels and with various aptitude patterns.

Readiness. Involved in instruction are behaviors imposed on subject matter learning such as paying attention, learning to learn, readiness, etc. These extra-subject matter behaviors also require explicit definition before they can be manipulated by specified instructional procedures. An illustration of this point is the contrast between the concept of readiness employed in education and the notion of "learning to learn" as studied by Harlow. Readiness is generally considered to be some function of maturation and previous learning, but has been rather ill-defined as specific responses that can be brought under the control of instructional procedures. Learning to learn, on the other hand, is concerned with intertrial improvement in the course of learning and has been brought more fully under experimental control than readiness. As a result, "learning to learn" defines a learning principle that is more ready for inclusion in an educational technology than "readiness". This distinction is discussed by Estes.

Reinforcement. There seems little doubt at the present time that a significant aspect of educational technology will be the management of reinforcing operations. As has been indicated, this should continue to be so despite the on-going development of learning theories to explain the process of acquisition. The central role of reinforcement in the acquisition of behavior is a long-standing empirical fact. Notwithstanding the various interpretations in terms of "law of effect"

and "contiguity," the operations employed in the course of manipulating the acquisition of a response are similar for the study of both types of explanatory theories. The concept of reinforcement states that behavior is acquired as a result of a contingent relationship between the response of an organism and a consequent event. Or, put another way, reinforcing operations are those which lead to acquisition when appropriately correlated with response occurrences. In general, "in its factual sense, reinforcement refers to any of a wide variety of conditions which may be introduced into the learning situation to increase the probability that a given response will reappear in the same situation." Both basic and applied research in learning are concerned not so much with what reinforcement is but with how it operates. What both endeavors can supply is a description of the variables which determine the effectiveness of certain reinforcing operations for achieving desired terminal responses.

Work in the science of learning has pointed up certain facts about reinforcement which seem to be firmly enough established so that they can be utilized in the applied investigations which lead to the development of an instructional technology. One of the facts about operations that are reinforcing is that there is an event that takes place as a consequence of the occurrence of a response. It seems obvious, then, that a principle in the design of instructional procedures should be the establishment of such a reinforcing contingency. This contingency is influenced by several factors in the learning situation. For example, it is necessary that a sufficient number of reinforced response evocations occur in order that the response is strengthened, i.e., its probability of occurrence is high in appropriate situations. A further well-established finding concerning response acquisition is that the contin-

gency between a response and a reinforcing event must be an immediate one. Delay of reinforcement may result in little or no learning. In instructional devices, this known fact about the delay of reinforcement has been taken most seriously in the development of teaching machines and programmed instruction. In school learning, one major reinforcing event for the student is "knowledge of results," that is, knowledge about whether or not the response he performs is a result considered correct. In programmed learning techniques, such confirmation is immediately forthcoming upon the completion of the student's response. The need to implement this fact of learning in educational technology is emphasized by the frequent delay of reinforcement that occurs in many classroom procedures.

Another finding in the study of reinforcement is the effect of the intermittency or scheduling of reinforcement contingencies. Essentially this refers to the fact that reinforcing events occur with different frequencies and in different patterns in the course of learning sequences. While a great deal of activity has concentrated on this aspect of reinforcement, it has had little applied development in educational procedures. It has been indicated (Skinner, 1938: Keller & Schoenfeld, 1950; Ferster & Skinner, 1957) that with an optimal schedule of intermittent reinforcement, higher and more stable rates of responding can be attained than with continuous reinforcement. Estes and his students have shown that the responses of individuals seem to be highly correlated with the overall proportion of reinforcement to non-reinforcement in a learning task. Estes states this finding in this way (1960, p. 760) ". . . the probability of the response will approach the probability of reinforcement. Thus we might expect that . . . if it were the case that 90% of English nouns encountered

by a student formed their plurals with 's' and 10% with 'n', we could expect that the student would form the plural of a newly encountered noun with 's' about 90% of the time." The effects of intermittent reinforcement probably vary with the kind of task being learned. The implication, however, for instructional procedures is that the effect of this factor is influential and requires applied research for appropriate practical implementation.

Interference and Transfer. As a general premise, it can be stated that interference in learning which results in forgetting and a decreased rate of acquisition is a function of competition between the response under consideration and other responses which have been learned prior to or subsequent to it. The results of experimental study in learning have indicated a number of variables to be considered in this connection. Transfer comes about as a result of stimulus components in several learning situations which are similiar to one another so that the response is generalized among these situations. The education of a student involves, to a great extent, two aspects: (a) learning to respond to similar elements in stimulus situations, i.e., to generalize so that all words of a certain class are called nouns, and (b) learning to make differential responses to different stimulus situations, i.e., to form discriminations such as differentiating between nouns and verbs. Much instructional procedure involves teaching students to generalize within stimulus classes and to discriminate between class instances. Interference in instruction often comes about in the course of this generalization-discrimination process, and research suggests that this can be overcome by practice sequences in which many response instances are presented which progressively narrow down the discriminations to be made. Such "discrimination sequences"

can be used to teach the student different responses to two stimulus situations which in the course of instruction might be confused. The sequence is set up so that the student responds correctly to the appropriate stimulus and also identifies situations in which a particular response is inappropriate. In so far as possible, the student is not permitted to perform an inappropriate response in the presence of a particular stimulus. Such a discrimination series should minimize interference resulting from the similarity of stimulus elements.

Interference may result from the introduction of emotional responses which are incompatible with the response to be learned. The results of learning experiments point up situations in which such emotional behavior is produced. In extinction, a response is permitted to occur in a situation where there are no contingent reinforcing events. As a result, the response attains a low strength and can be replaced by a response which is more frequently reinforced. In the course of extinction, it is noted that emotional or frustration behavior occurs. It has also been found that after a history of continuous reinforcement, the omission of a reinforcement is frustrating and similarly results in certain emotional behaviors which may be incompatible with learning the appropriate response. In the development of instructional methodology it seems desirable to minimize the possibility of the occurrence of such behaviors. A way of implementing this might be to provide a history of intermittent reinforcement and thus subsequent omission of a reinforcing event would be much less frustrating.

In training and education there has been much concern about transfer of training. The behavior of interest in this respect is the ability to utilize one's learning in stimulus situations which differ to some extent from those in which learning occurred. Interference in the

application of learning to these new situations often arises. The existence of positive or negative transfer can be presumed to be a function of the generalization-discrimination sequences that occur in learning. The notions of generalization and discrimination indicate that the search for transferable elements is less useful for the development of an instructional technology than is the study of the production of transfer as a result of practice with graded sets of experiences containing a variety of instances with varying stimulus characteristics. This will be further elaborated in the section on reasoning and understanding.

A pervasive body of research in the psychology of learning is the work on interference in verbal learning that is characterized by the investigations of Underwood and others. Here the effect of a host of factors on the learning of a restricted class of verbal behavior has been studied. These factors include such variables as meaningfulness, task similarity, active recitation versus passive study, affective characteristics of the material, whole versus part learning, and such dependent variables as spread of effect and incidental learning. The relationship of these factors to classroom learning may be difficult to see in a direct manner, but it should be possible to determine their relevance to instructional technology through classroom experimentation.

Practice and Review. It is established that review and repetition are necessary in the process of acquisition and for the maintenance of previous learning. The conditions of practice over the course of learning trials are indicated by many of the aspects of learning discussed above. The general implication for instructional procedures is that these procedures must incorporate the appropriate amount of

review and repetition necessary to maintain previous learning and to maintain already learned concepts which need to be strengthened and utilized in further learning. Sufficient practice is necessary so that early material is mastered before or while new material is introduced. Practice should incorporate the conditions which facilitate learning. However, for many subject matters, the effects of particular characteristics of practice and review upon response strength and retention are not known and must be determined by empirical classroom investigation.

The distribution of practice has been a very frequent variable in experimental study, and at the present time, many experimental psychologists would agree that learning appears to be most effective, i.e., acquisition is faster and performance levels are higher, when practice is spaced, that is, divided into a number of daily trials. This would suggest that instructional techniques should be studied in which practice is interspersed with other aspects of instruction.

Reasoning and Understanding. When prescriptions for definitive instructional programs are presented, a frequent statement made by teachers goes something like this: "Yes, the student seems to be learning, but does he really understand?" The reply to this question refers to the observable terminal behavior desired by the teacher. The reply goes something like this: "Tell me what kind of behaviors (perhaps test performance) you would like the student to display so that you know he is understanding and reasoning." With such terminal responses specified, it is then the task of instructional technology to determine what combination of learning experiences (including teachers, devices, and self-study) result in this behavior.

The terminal behaviors defined as understanding, concept formation and concept utilization, and reasoning seem to be brought about by

continuous variations of the stimulus context in which the student responds. This stimulus variation can be set up in the instructional process so that the student gradually receives new information, learns to make finer discriminations and appropriate generalizations, and learns to apply his responses to a wide variety of situations. This has the effect of enriching the student's breadth of learning and is an operational way of defining the development of understanding. Instructional sequences can provide a series of well-organized examples by which the student is led to develop abstractions and complicated concepts. An important goal is to "enrich the student's understanding" by inducing him to permute and recombine the elements of his repertoire. At the extreme of these stimulus and response variations, the goal of instruction is really not concerned with the student's response to any one situation. This is only an example of an abstraction. The educational objective is that the student acquire not a uniform and explicit set of responses about the concept, but rather acquire a repertoire which is applicable in a variety of situations so that he can use the concept to solve problems, describe it to others, modify it for certain purposes, build a model of it, and so forth. Such terminal behavior can be defined as reasoning with or understanding a concept. Appropriately designed instructional sequences including various kinds of learning experiences can provide this stimulus and response variation which contributes to the growth of understanding.

Motivation. When one measuresthe usefulness of a learning concept in terms of the extent to which it generates applications for instructional research and practice, the concept of motivation does not fare well. The theoretical and experimental concerns with this concept do not present readily translatable findings. In fact, many leading theorists

have avoided the word in their conceptual thinking in the attempt to account for learning phenomena in more operational terms. In view of the state of the concept of motivation, one is tempted to say that motivation includes those events and operations that make a particular response-event contingency reinforcing. Such a statement is, in large part, an expression of ignorance of a variety of factors in the learning situation which need to be identified. Motivation, as studied, has been related to drives which are produced by certain experiences in an organism's history. In the laboratory, the operation of deprivation, e.g., of food and water, has been employed to make certain events reinforcing. It taxes one's ingenuity, however, to see how deprivation can be employed in instructional practice unless it can be conceived as withholding reinforcement. Furthermore, much research is required to investigate the nature and use of secondary reinforcers such as school grades, being correct, approval, and status.

Sometimes the word motivation is used to imply certain behaviors that are the outcomes of instruction, for example, when a student continues to study after the usual classroom hours, when he works on special projects on his own, or when he uses the library to look up topics related to his school subjects. When a student does these things he is often referred to as being "well motivated." When motivation is used in this way it is best to state such terminal objectives in behavioral terms and then introduce instructional practices that produce these behaviors. The judicious use of reinforcement is motivating in this sense. When a student receives frequent reinforcement in the course of learning, he often appears to become very interested in the subject matter and his constant success in handling it makes him act in a way that one would call "motivated." It is of course presumptuous to attempt

to talk in any definitive way about the problem of student motivation. Much research still needs to be considered. For technological purposes, it seems practical at the present time to define the terminal behaviors which fall into a class called "showing motivation." The task then is to manipulate the instructional situation in a way so that these behaviors can be produced with some degree of consistency.

Performance Assessment. During a course of instruction and at its end, the performance of the student needs to be measured. Such measurement provides information about the extent to which auxiliary and terminal behaviors have been attained. This information can be used to decide upon the course of subsequent instruction and to determine the extent to which certain standards of proficiency have been reached. In an instructional system there are two primary uses made of the results of performance assessment. One is to provide information about a student's present behavior; measurement for this purpose is primarily designed to discriminate between individuals. The second use is to provide information about the instructional techniques which produced that behavior; measurement for this purpose is designed to discriminate between instructional methods.

The assessment of performance is desirable in several phases of an instructional system. Measurements of behavior are frequently made, as has been indicated, in assessing the entering repertoire of the student. These measures take the form of aptitude tests or tests of "job knowledge" or "educational placement." However, by placing the performance assessment phase after the instructional procedures in the simplified diagram of an instructional system give earlier, the intention is to emphasize the assessment of terminal behavior. As instruction proceeds and particular units of instruction are completed, performance assess-

ment is employed as a kind of quality control in order to determine whether the student has reached or surpassed terminal performance standards that have been established.

Underlying the concept of performance assessment is the assumption of a continuum of subject-matter skills, ranging from low proficiency to high proficiency. A student's performance at a given subject-matter task falls at some point along this continuum, as measured by the behavior he displays during testing. The standard against which an individual's performance can be compared consists of the behaviors which define the points along the underlying skill continuum. Performance levels can be established at any point in the course of instruction where it is necessary to obtain information about the adequacy of a student's performance. The specific behaviors implied by each level of proficiency can be identified and used to describe the specific subject content skills that a student is capable of performing as he achieves a particular level. In this sense, performance measures can be "content-referenced" in terms of specific task accomplishments falling along a continuum of proficiency.

In contrast to content-referenced measures where the performance of an individual is compared with specific subject-matter skills, performance assessment information is frequently expressed in terms of "norms" where a student's performance is compared with or relative to the performance of other individuals. In much of current practice, an individual's relative standing along the underlying proficiency dimension is the primary information required and reference need not be made to subject-matter content. Educational achievement examinations, for example, are often used primarily to order students in a class in terms of "grades on a curve." When such norm-referenced measures are used,

a student's proficiency is evaluated in terms of a comparison between his performance and performance of other members of the group, e.g., in terms of a percentile score. Measures of this kind provide little information about the degree of student achievement in terms of what behaviors he can actually perform. Norm-referenced measures supply information that one student is more or less proficient than another student but do not provide information about how proficient either of them are with respect to the specified terminal behavior of instruction. The distinction made here between content-referenced and norm-referenced measures of the outcomes of instruction is similar to that made by Flanagan (1951) and Ebel (1960). They have suggested that most achievement measures used in education are norm-referenced and thus do not provide the degree of information, both order (relative standing) and content, made available by the use of content-referenced measures. In the kind of instructional system being outlined, content-referenced scores could supply appropriate information about the adequacy with which a particular instructional situation produces its specified instructional objectives.

Incidental Training

Two Solutions Worthy of Adoption. The first example pertains to the experiences and failures of Joseph Mayer Rice. Robert M.W. Travers aptly depicts the plight of Rice in the following manner:

> Rice was a physician by profession, but after a rather brief practice of medicine during the years 1881-88 became interested in problems of education and left for a two-year visit to Europe where he studied pedagogy and psychology at two great centers of educational thought, namely, Jena and Leipzig. Rice undoubtedly came under the Herbartian influence as well as that of Wundt and in 1890 returned to America fired with a zeal for educational reform. Like most reformers, his immediate impulse was to tell the public in strong terms that the time for reform had come, and

> this he did in a forceful article picturesquely entitled "Need School Be A Blight to Child-Life" (1891). In this article he compared some schools he had observed in Germany where "education is regulated more or less mechanically." Perhaps the readers considered the comparison of German schcols with American schools invidious. Public reaction was nil. To bring his case before an even wider public and to expand in detail on the need for educational reform he followed his article with a book entitled THE PUBLIC SCHOOL SYSTEM OF THE UNITED STATES (1893) in which he summarized the observations he had made on 1200 teachers located in St. Louis and Minneapolis in the Middle West. The book was hardly more successful than the article. Educators paid no attention to the opinions of a layman, who in professional circles rapidly became dubbed as a crackpot. Legend relates that he was met with jeers when he attempted to present his findings to a meeting of the National Education Association.
>
> Like most reformers, Rice was a man dedicated to his cause. If his observations in the classroom were to be brushed aside as the worthless opinions of an amateur, then what he needed was a carefully collected compilation of facts. In terms of the mood of educators in Germany, from which he had so recently returned, this was to be not only the preferred, but also the only sound way of producing educational change. Thus in 1895 he set out to collect information about the skills of school children in arithmetic, spelling, and languages and to relate those skills to the way in which the children had been taught. On the basis of these studies he found that the amount of time devoted to spelling could be at least halved without any reduction in the level of skill which would be acquired. The results of his study of spelling appeared in a new article in the FORUM under the fetching title of "Futility of the Spelling Grind" (1897). Other articles presented data attacking other aspects of current teaching in the schools and finally the entire research enterprise was drawn together in a book entitled SCIENTIFIC MANAGEMENT IN EDUCATION (1913).
>
> Rice's effort to produce educational reform had absolutely no effect on his contemporaries. The outcry of public indignation which he expected would arise as a result of the publication of his research never even reached the level of a murmur. Professional educators could not have shown less response to his findings and recommendations, for little reference is found to him in the educational literature of the period. Yet 50 years later one finds that most of the reforms towards which he had directed his efforts have been incorporated in education. Progressive education of the mid-30's might well have derived its charter from the writings of Rice in the mid-90's. One also finds 50 years later that it is still not the research scientist who brings reform to education. (41)

Unfortunately, Rice does not stand alone. Considerable scientific research has been reported in the professional literature since the days of Rice;

yet, the impact of these practices seems to be slight.

The second example was called by Lewis M. Terman "one of the most important contributions thus far made to the problems of higher education in the United States." He compared this study to the Flexner report on medical education and practice. A bulletin describing the study includes this paragraph:

> The study is a landmark in the passing of the system of units and credits, which, useful as it was a third of a century ago, is not good enough for American education today. On a number of pages the Bulletin emphasizes the fact that the "package method" of academic advancement has served its purposes. American higher education appears to be well on its way to another stage of development in which promotion, at least in college, will be based upon "the attainments of minds thoroughly stored and competent." The authors urge that the student who is ready to go ahead be not hampered by traditional, formalized administrative conventions. Academic progress is to be governed by demonstrative achievements, rather than by the conventional time standards.

Can the reader use these clues to identify the study being discussed, and can he assess the study's impact upon contemporary education?

The study, supported and published by the Carnegie Foundation for the Advancement of Teaching in 1938 under the Title, The Student and His Knowledge, focused upon the relations of secondary and higher education in Pennsylvania. William S. Learned and Ben D. Wood proposed (1) to fix attention primarily on the nature, the apparent needs, and the actual achievements of the individual student in his successful contacts with existing institutional forms; and (2) to consider the educational performance of school and college as a single cumulative process of which, for any given student, should be complementary. (42) Their investigation consisted of two parts: first, a comprehensive examination administered to 4,580 graduating seniors in 49 Pennsylvania colleges, presumably to depict the accumulated intellectual funds of the class of 1928; and second, a comprehensive examination administered to

the graduating seniors of 1928 of the public and private secondary schools of Pennsylvania and to the 27,000 seniors who enrolled in institutions of higher learning within the state again in 1930 and in 1932 presumably to derive a measure of academic growth.

Their study, referred to as the Pennsylvania Study, was a valuable undertaking. It revealed the enormous differences among colleges and among students enrolled in specific colleges; it convincingly exposed the weakness of the course-credit system as a measure of educational achievement; it focused upon the inadequacies of teacher trainees in Pennsylvania colleges; and as the first state-wide evaluative testing survey, it set a new standard for systematic research inquiry.

Now, what impact did the Learned/Wood effort have upon involved educational institutions in Pennsylvania in particular and upon educational institutions in general that might be influenced by the evidence? Wood wrote in 1964 that the situation which was so dramatically exposed is still largely with us. "We still have colleges," he noted, "that regularly graduate classes that, in ordinary high school English reading and vocabulary tests, average at the senior high level, although there are many colleges whose freshmen stand entirely above the whole population of some of these low colleges." (45) Perhaps Wood criticized the impact of his study effort too severely.

Granted significant variability among given college populations continues, the course-credit system still rules the land, and institutional teacher training programs leave much to be desired. However, the research approach employed by Learned and Wood may yield serendipitous dividends in the hands of contemporary psychometrists. Society is placing more and more emphasis upon standardized, independently derived measures to determine a person's capabilities and performance level.

As this approach evolves and matures, the calibre of college graduates, the course-credit system, and the training of teachers may be effected accordingly.

Here is an example of a study which was carefully planned and executed, which yielded significant information, yet which failed to alter the behavior of very many pedagogical practitioners. The account is used to focus upon the process of influencing or changing the practice of individuals within institutional settings.

Diffusion and Utilization Factors of Importance. These two examples of jobs well done illustrate the point that better mousetraps actually exerted little influence upon potential target audiences. Undoubtedly, many other similar experiences could have been selected to illustrate the point intended. Now, what must be done above and beyond the efforts of Rice, Learned and Wood, to modify the behavior of pedagogical practitioners? Analyses of fields that are routinely influenced and modified by scientifically derived information provide clues to the essence of their success. These fields try to incorporate all or part of the following practices:

1. A network of respected, believable knowledge producers;
2. A source of venturesome technicians and interpreters;
3. Facilities for field testing knowledge offered;
4. Well-defined and respected communication channels through which information is effectively offered to designated audiences;
5. An information storage and retrieval service;
6. A cadre of diffusion agents functioning at a grass roots level to insure that worthy knowledge is adopted;
7. Economic incentives for the adaptation of innovations offered.

Perhaps the fields of agriculture, medicine, and certain governmental

agencies best reflect these characteristics.

When these seven practices are applied to education, one can readily perceive why the researcher's contributions to the field are received in a haphazard manner. While the field has reliable knowledge producers, interpreters usually prove to be graduate students who have other competing concerns, marketing strategies seldom are seriously cogitated, and information storage and retrieval is in a primitive state. No well-defined and respected communication channel exists to effectively diffuse research contributions to appropriate target audiences. A cadre of diffusion agents functioning at the grass roots level is absent. And, practitioners are accustomed to adopting innovations offered without benefit of evidence of their effectiveness and without clear-cut comprehension of their implementation.

When components associated with specific illustrations of change are studied for the purpose of extracting a set which may be generalized to many diverse situations, problems arise. For example, either social disorganization or clever marketing may account for the success of a given innovation. As diverse as these factors may appear, both deserve a place in the generalizable set under the category conditions for change. If an innovator effervesces a fair amount of charisma and if he is willing to delve into the applied realities of innovation diffusion and utilization, he will probably be more successful than innovators who lack charisma and a flair for application. Characteristics of the innovator are certainly important; yet, they are most difficult to delimit for study purposes. The complexity of an innovation dictates a number of subsequent requirements such as specialized personnel, training, resources, or facilities; the level of change called for; the formality of communication channels needed; and the investment of time and effort necessary

to enable prospective clients to adopt the innovation. Fortunately, this component can be treated more easily than the previously mentioned components. Finally, characteristics of the target audience need to be taken into account prior to the diffusion effort. In fact, detailed knowledge of the recipients ought to contribute vitally to diffusion strategies employed by innovators. Since little is known about educational consumer behavior at present, much baseline descriptive work is needed.

To summarize, conditions for change, characteristics of the innovator, the complexity of the innovation, and characteristics of the target audience seem to be overarching factors of importance to the adoption process. Within the context of each factor there exists an indeterminate constellation of sub-factors. These sub-factors are influenced by the complexity of an innovation offered, and can be delineated for study without too much difficulty. Further study may ultimately reveal universal sub-factors within each of the four overarching categories; however, the amorhpus and speculative state of information about educational knowledge diffusion and utilization calls for more clarity before systematic efforts to uncover such sub-factors can be inititated.

Two USOE supported regional laboratories initiated studies of a role for the field of educational comparable to that of the county extension agent. The Cooperative Educational Research Laboratory Incorporated (CERLI) embarked upon one strategy and the Far West Laboratory for Educational Research and Development (FWLERD) entered into a second.

CERLI envisioned the development of a new specialized personnel role and its institutionalization within educational systems as one

means of bridging the gap between innovation and implementation within the appropriate target settings. Hence, this organization invested a major portion of its resources to develop a different kind of change agent, a specialist in continuing education (SCE), for the field of education. In this role, an SCE would work primarily with individuals and small groups of pedagogues in the place of practice.

The SCE position put forth by CERLI is based upon assumptions like the following:

1. it facilitates peer working relationships rather than either an authoritarian or evaluative relationship;

2. it introduces a definite intermediate linkage between knowledge generators and knowledge utilizers;

3. it encourages self-directed activity on the part of practitioners and creates a setting within which such behavior is rewarded.

4. it focuses upon goal directed activity on the part of practitioners;

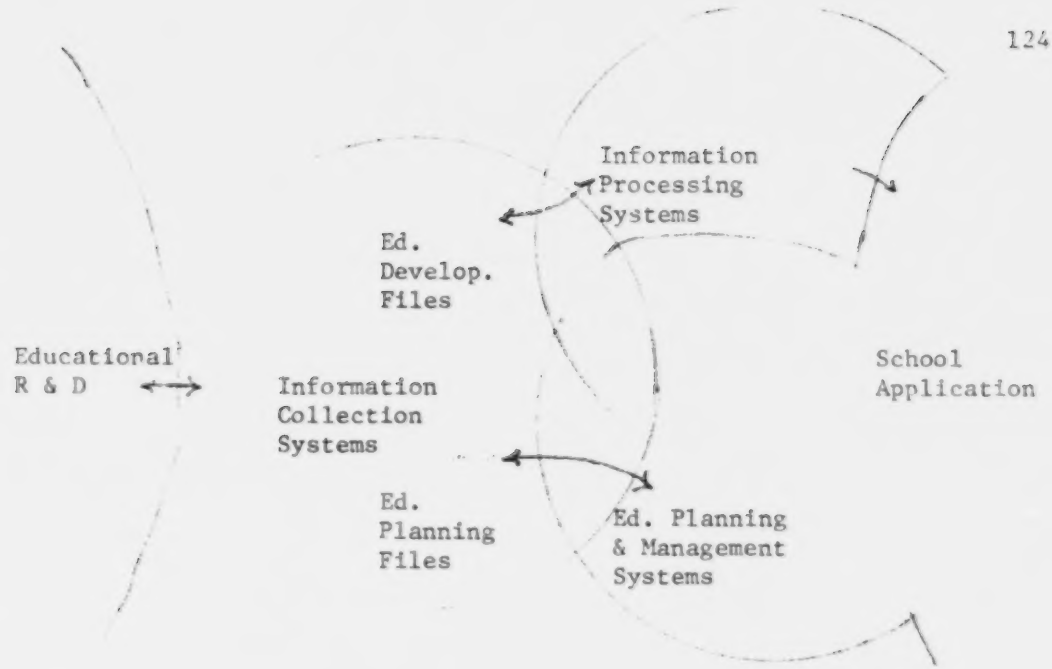
5. it can obtain appropriate information, not generally accessible to practitioners, and bring it to bear upon problems being studied;

6. it makes possible a systematic approach to an individual's and a staff's professional self development.

Unfortunately, CERLI went out of business before it could realize the fruits of its endeavor.

The Communication Program of FWLERD initially set about to develop a set of integrated information systems. The first system is concerned with the problems of information search, retrieval and storage; the second system is involved in the processing of information; and, the third in the development of systems arrangements and capabilities by which to optimized the use of information.

The figure on the next page depicts the relationships among these systems.



Through the development and operation of these systems the Laboratory aimed to reduce the gap between educational research and development and its application in schools. More specifically:

- The Information Collection System searches the R & D domain for information relevant to educational developments and educational planning, retrieves the information, and organizes and stores it in two files: the educational development files and the educational planning files. The educational development files provide information to the Information Processing System. It is anticipated that by the end of 1970 descriptions of some 1,000 educational developments will be stored and indexed in these files with speedy retrieval capability. The Educational Planning Files feed into Educational Planning and Management Systems.

- The Information Processing System organizes information on educational developments in a form to be of optimum use for schools. Products of this system are packaged information units that present recent developments in a variety of curriculum subject matter areas. Each unit is a self-contained, multimedia, mailable information package. Information on tested new alternatives within given curricular or instructional boundaries is compiled, analyzed and processed in a manageable format.

The first completed information package analyzes six well developed elementary science programs. The multimedia components are filmstrips, audio tapes and booklets.

Two other information packages are at the stage of advanced development--one in secondary school American government and the other in the elementary-level individualized instruction programs. Other areas in which development has commenced include early childhood education and reading. On the drawing board, is a plan for a "second generation information system." Established as part of walk-in educational information centers, this system will guide the user to a set of curriculum alternatives in any subject matter domain and will enable him to select the one best fitting his needs and resources.

- The Educational Planning and Management System is developing a set of tested alternative prototypes by which schools can plan and manage their educational programs more effectively. The implementation of a prototype appropriate to specific needs, requirements and resources will allow a school to assess its existing capabilities for instructional planning; select appropriate organizational arrangements; train its personnel; and plan, program, manage, evaluate and revise the arrangements selected. The current thrust of this developmental effort is to design and test a set of programs by which to train school personnel involved in instructional planning and decision making.

Laboratory personnel engaged in this work recently began to explore a new role for an educational change agent to complete the systems thrust. Their work is akin to CERLI's undertaking, but it is not nearly as grandiose. The role, as currently viewed, requires much less formal training, has more clearly defined job specifications, and is tuned into the three evolving information systems. This is certainly

a most promising undertaking!

It is from this kind of research and development that educators can expect to acquire expertise and build program inventories needed to meet the educational information systems needs of the '70's. Faced with ever-growing requirements, however, present research appears to be far short of being adequate. It is thus imperative that increasing attention be paid to, and more resources made available for, the continuance and expansion of both research and development in the design of educational information systems.

CONCLUSIONS

Specific Training

At first glance, one working in the field of training research would expect that the measurement of actual performance on the job would have received a great deal of research attention over the years. After all, one would reason, there is no way of knowing how to train people unless you can measure, first of all, how they perform when they are finally assigned to a job.

Unfortunately, this has not been the case. Historically, observed Clark Wilson (45), except for ratings and other gross measures, relatively little attention has been paid to the real problem of measuring how well a person can perform the actual task for which he is trained. Applied psychologists, educators and training specialists have produced great numbers of reports on training assessment, but the vast majority use school graduation or classroom measuring instruments. To all intents and purposes one finds only isolated attempts to measure performance on the job by other than rating methods when that performance was intended to serve as a measure of the effectiveness of the training that preceeded it. Put another way, the amount of such measurement research in proportion to the amount of training is discouragingly small.

With this rather peculiar history it is desirable to place the whole problem of on-the-job performance measurement in its proper current perspective. The first consideration is the practical research

climate. In the past 50 years most of the research talent and effort available for practical personnel research has been directed toward selection studies. Compared to the magnitude of research on selection, training has been relatively, though not entirely, neglected.

Further in this vein, the selection research that has been done has been aimed at predictor development with inadequate attention to criteria. Here, also, the bulk of criterion development has been based on ratings as a technique. Jones (44) reviewed 2100 selection study reports published prior to 1948 and found that only 427 even mentioned a quantitative validity coefficient. Only eight studies (.04% of the total) gave any statistical information, such as the reliability of the criterion. Thus the area of selection research has been developing without any real, or surely not adequate, attention to measurement of the final criteria. Considering both training and selection, the latter being the predominant area of the two, it appears that researchers in both areas have been equally neglectful. The need for better criterion development has not been felt sufficiently strongly to spur action.

A second practical consideration is the fact that most persons interested in training research have been employed in training or school situations. As a natural consequence they use end-of-course measurement as criteria. The use of on-the-job measurements has rarely been adopted. It must be said that these school criteria are often, no doubt, highly valuable and serviceable. Some situations exist, surely, in which they are fully sufficient. There are others in which on-the-job measurements are just not feasible. The main point, here, is that there has been little strong interest in actual on-the-job performance measures among many of the people who could profit most by them.

There have been other reasons for the lag in the development of these devices. For one thing, practical performance tests often require measuring one person at a time while written tests and rating scales can handle groups, thus the expense is high. Also the graduates of a single school are often scattered into many locations. If the school researcher wants to follow his graduates, his costs and problems, including sampling difficulties, mount out of proportion.

Under the cricumstances, one is faced with the question of whether or not any more precise measuring devices are really required. If training research people have been getting along over the years with end-of-course and classroom measurements and on-the-job ratings, then "is there a need for anything more?" To set these aspects into perspective the functional and theoretical considerations that form the basis of the need for better measuring approaches must be viewed.

The basic role of an effective measurement of a person's on-the-job performance is to feed information back to the person who is responsible for his training either at school or on the job. In other words, in the training research context, the only reason for measuring the level of performance of a person on the job is to provide criterion information to those who are responsible for his training. These responsible people may be working with him in a combined training-supervisory capacity, or they may be responsible for a program through which the individual passed before he was assigned (or returned) to a job. Most of these people seem content with the calibre of current information.

The design of training programs for complex skills ordinarily involves a combination of "expert judgment" and known principles of

learning. The emphasis is generally on "common sense" procedures. Recent writers, noted Fleishman (45), have stressed the opinion that the laws of learning, developed in the laboratory, have for the most part not been applicable to operational training problems. There are many reasons for this, not the least of which is the lack of understanding of the learning process itself, especially in cases of more complex performances. There is at present, for example, a lack of knowledge of the manner in which principles of learning are related to particular characteristics of the tasks learned. This, of course, is related to the question of how well it is possible to generalize the usefulness of learning principles from one task to another. Or, to relate the usefulness of these principles to on-the-job performance.

Given the above reservations related to the phenomenon of specific training, one section of the literature cited--the section on military training--does stand out as an exemplar of generally successful behavioral modification. Many of the military training programs described were influencing trainee behavior in practice. And many of the military training circumstances seemed compatible with circumstances confronted by educators. Educators might profitably invest their energies in analyzing the specific dimensions of successful military programs.

Glaser's component phases of an instructional system (mentioned in the previous section) seem to be necessary and sufficient for the conduct of training experiences which apply to practical operating situations. Many military programs reflect the flavor of Glaser's scheme; few non-military programs do so. If training program planners take into account this scheme, it is not unreasonable to believe trainee behavior can be successfully modified--and done so in a predictable manner.

Incidental Training

The rural sociology tradition has proven to be a most successful alternative to specific training as another means of modifying human behavior. This tradition charges trained individuals, situated in the context of "subjects'" practice, with the responsibility for altering or extending the nature of current practice. These specialists take into account factors such as conditions for change, characteristics of the innovator, complexity of an innovation, and characteristics of the target audience. They interact with selected elements of a population earmarked for "change" until the mechanism for change becomes self-sustaining. Their efforts have contributed to a spectacularly successful national agricultural enterprise.

It was an unfortunate twist of history that exposed the field of education to Federal training opportunities like the NSF and NDEA institutes programs. History (and this report) realistically judged. Had the billions of dollars invested in programs like NSF and NDEA been used to establish an educational extension service modeled after the agricultural extension service, there is considerable reason to believe the pedagogical payoff would have been significant. Behavioral modification would not have been the victim of fortuitous whim, but rather would have become the responsibility of numerous individuals specifically trained to accomplish tasks set forth.

Steps are now being taken within the field of education that might establish a structure for behavioral modification somewhat stronger than the institutes program but perhaps not as powerful as the agricultural extension service. The Communications Program of the FWLERD represents one agency that is developing strategies designed to modify behavior with little or no specific training. While current laboratory

work is promising, it is too soon to judge the undertaking.

Certainly "Sesame Street's" success as a powerful instructional force deserves serious attention. Already NBC is experimenting with Gattegno's "Words in Color" strategy of reading to be produced as sixty second "Pop-ups" and inserted during children's cartoon shows. Educators still are scratching the surface trying to figure out how to use television as an instructional tool. The medium offers considerable promise, and in the hands of educational "extension agents" it might be used for a variety of specific behavioral modification purposes.

The field of education seems to be most appropriate for the development of an educational extension service. And this type of service offers possibilities for modifying behavior that certainly would augment existing training opportunities if not exceed the outcomes of many of them.

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